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# THE HISTORY AND DEVELOPMENT OF THE FISHERIES OF THE COLUMBIA RIVER

By Joseph A. Craig and Robert L. Hacker

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# THE HISTORY AND DEVELOPMENT OF THE FISHERIES OF THE COLUMBIA RIVER [1]

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By JOSEPH A. CRAIG, M. A., *Associate Aquatic Biologist*, and ROBERT L. HACKER, M. S., *Temporary Assistant, United States Bureau of Fisheries*

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# INTRODUCTION

Stocks of fish native to the Columbia River support a large industry and provide a considerable income for the inhabitants of the region. A few general facts and figures will serve to demonstrate this. During the 5-year period from 1928 to 1932, inclusive, the average annual production of these fisheries was approximately 29,800,000 pounds of fish. In that same period the fishermen, averaging 3,820 in number, received a yearly average income of about $2,425,000. The above-quoted figures of production and value include troll-caught salmon landed at Columbia River buying stations, but not elsewhere. Ocean fish caught by trawl and set lines in the Columbia River district have been excluded. The values of the related industries of box and can making, etc., are not included. From tagging experiments and other sources of information, it is known that the Columbia River contributes a very significant portion of the catch of the ocean fishery.

It has been estimated that the value of the products of the Columbia River fisheries, plus that part of the output of the ocean fisheries which the Columbia River salmon contribute, is about $10,000,000 annually when delivered to the consumer. This is probably a fair approximation of the annual value of Columbia River fisheries to the people at large. However, it should be remembered that this $10,000,000 is merely the yearly income, or profit which has been taken each year for a great many years. Therefore, it must be regarded in the same light as the interest from money invested, or dividends from stock purchased. The capital from which this income is derived is the population of fish in the Columbia River and, as long as adequate breeding stocks are maintained, this annual profit may continue to be taken. Four percent annually is a fair rate of return from a safe and conservative investment. So, if we assume that the $10,000,000 annual income from the fisheries is the return from an investment paying at the rate of 4 percent per annum, the value of the capital invested, or, in this case, the population of fish in the Columbia River, is approximately $250,000,000.

This large industry is supported and maintained by the population of migratory fishes living and spawning in the Columbia River. The salmon are by far the most important species, both in terms of value and poundage produced. There are four species of Pacific salmon: *Oncorhynchus tschawytscha*, or chinook; *O. kisutch*, or silver salmon; *O. nerka*, or blueback salmon; and *O. keta*, or chum salmon, which form the bulk of the Columbia River's contributions to our commercial fisheries. All of these species are anadromous and all die after spawning. The remainder of the catch is composed of steelhead trout, shad, smelt, sturgeon, and crayfish. The Columbia is the principal steelhead-trout stream of the Pacific coast.

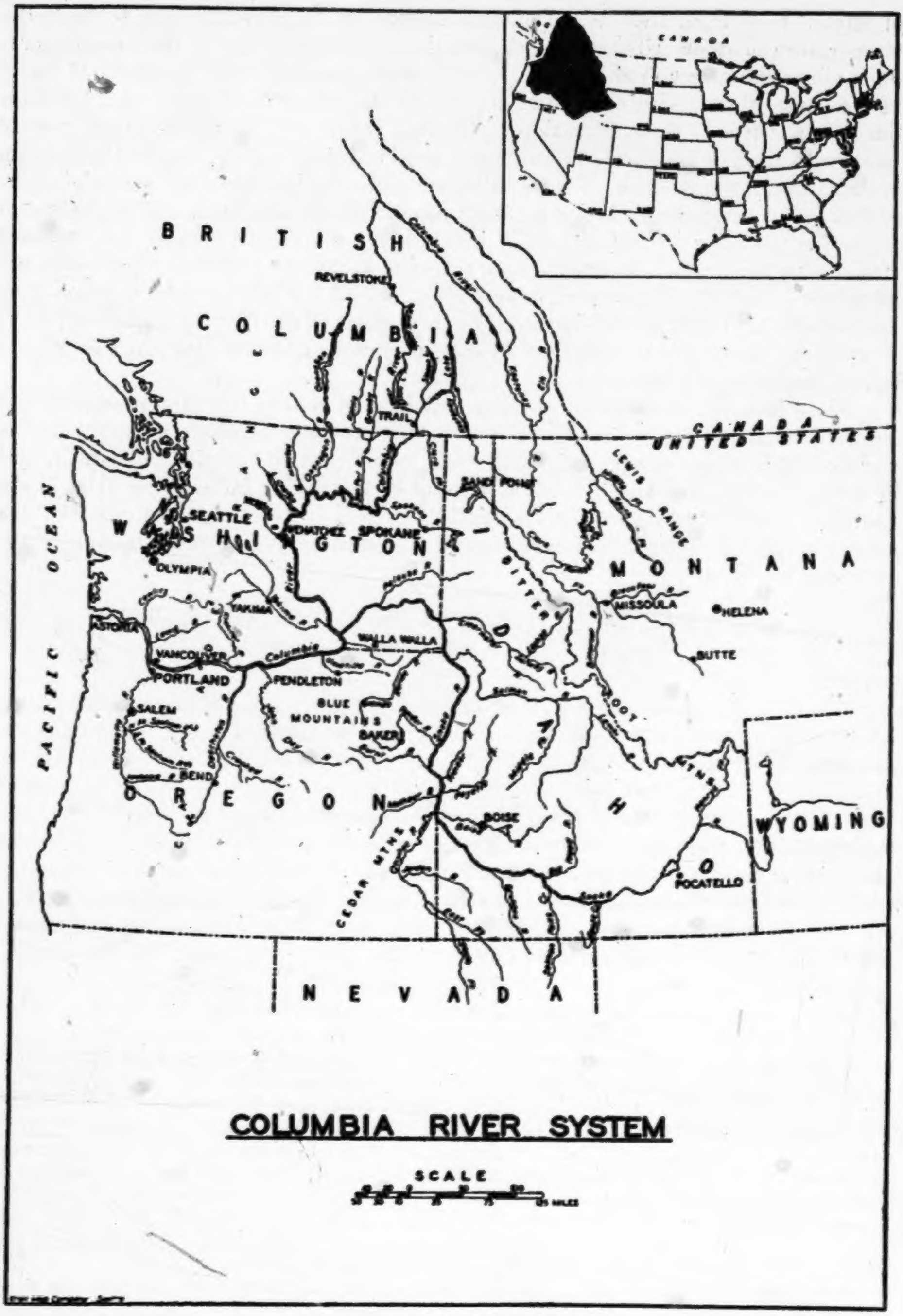
Obviously this industry can continue at a high and profitable level only as long as the breeding stock of the population is kept at sufficient numbers and permitted to have such favorable conditions that an annual surplus can be taken by the commercial fishery. The same factors apply to a stock of domestic animals or fowls. Adequate numbers of breeding animals must be maintained and provided with suitable living and food conditions if the business of fowl or stock raising is to be a continuous success. A program of research has been designed to answer the fundamental and important questions in regard to the Columbia River fisheries, so that we may have the information necessary to insure the conditions required for their continued usefulness. These scientific investigations are being carried on under an appropriation which was made by the Congress because, during the years 1922 to 1931, inclusive, some $400,000 was paid into the United States Treasury for leases to the seining grounds on Sand Island, at the mouth of the Columbia River, and it was desired to invest these funds, which have been derived from the fisheries of the Columbia River, back into this resource so that its future stability and productivity might be assured.

Since this is the first publication on the results of these investigations, it might be well to mention the general program. It is necessary that we have some measure of the changes in the numbers or abundance of the fish populations from year to year and during each fishing season. The need for this information is obvious. We must know whether or not so many fish are being taken that their numbers are declining and the breeding stock being endangered. This part of the problem is being answered by a statistical study of the catch records of the commercial fishery which will provide us with indices of relative abundance worked out on the basis of the catch per unit of fishing gear and effort.

Another major phase of the investigative program has to do with the life histories and habits of the species of fish contributing to the fishery. We must know the age of maturity of the salmons, their age upon leaving fresh water, their reactions when transplanted at various ages, and many other pertinent facts if we are to correctly interpret the indices of abundance and devise a sound program for the protection and rehabilitation of these fisheries.

The conditions obtaining on the spawning grounds and the fresh-water habitats of these various species of fish should also be known. The extent and quality of available spawning grounds, the location and character of natural or man-made obstructions which block or interfere with the migration of fishes, the species and number of fish inhabiting various tributaries, sources of pollution, number and location of irrigation diversions, water temperatures and flows of the tributaries, and many other pertinent facts are needed to make the picture of the condition of the fresh-water habitats complete. These data are being secured by stream-survey parties which will cover that portion of the Columbia River system which lies within the boundaries of the United States. Counting weirs are also being operated in certain important key streams, so that the numbers of salmon and other migratory fishes ascending these tributaries may be known.

The area drained by the Columbia River and its tributaries has been undergoing a process of civilization and development for approximately a hundred years. The commercial fisheries have been developed. Agricultural land has been put into use, timber has been cut and utilized, and the mineral resources exploited. Extensive power and irrigation projects have been completed. Many cities and towns have been established and numerous manufacturing and urban industries created. All of these developments influence, in some measure, the fisheries and fish populations of the Columbia River. The fishery, of course, takes a direct toll from the fish population, and its effect is manifest. Agriculture and stock raising make necessary the clearing of land and pasturing of stock, which at times cause soil erosion and the destruction of cover along stream banks with a resultant silting of gravels or scouring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PORTLAND
PENDLETON
SALEM
BLUE MOUNTAINS
BAKER
IDAHO
BEND
OREGON
BOISE
WYOMING
CEDAR MTNS
POCATELLO
NEVADA
COLUMBIA RIVER SYSTEM
SCALE

Figure 1.—The Columbia River system.

of stream beds from freshets. Denuded stream banks allow the sun to raise the temperature of small tributaries and, because of the lack of vegetation, do not produce abundant insect food for fish. Lumbering operations also bring about many of the same effects, with additional damage to the fishery from dams and log jams blocking the fish in their migrations. In some instances mining operations pollute streams with waste products. Both power and irrigation projects require the erection of dams across the streams. These structures retard or block entirely the migrations of fish unless adequate facilities for their protection are provided. Also, the use of water for power or irrigation usually involves the diversion of water from natural stream channels. Such diversions may take out so much water that the streams are no longer suitable for fish travel, or residence, or lead the fish into places where they are destroyed. Cities and towns often pollute streams by discharging sewage and other wastes into them, and manufacturing and other industries are also often sources of stream pollution.

Since it is evident that all of these activities in general, and the prosecution of the fisheries in particular, have a profound effect on the population of fish inhabiting the Columbia River, it appears worth while to attempt to compile a general record of their developments and a detailed account of the fishing industry to date on the Columbia River. It is hoped that this history will serve as a background for the other investigations which will be made and promulgate a better understanding of the problems involved.

## GENERAL DESCRIPTION OF THE COLUMBIA RIVER AND ITS BASIN

The main channel of the Columbia River serves as the pathway by which the adult salmon, steelhead trout, shad, smelt, and other migratory fish move from the ocean to the smaller tributaries and upper reaches where they spawn, and as the means of egress into the sea for the young offspring as they seek their salt-water habitat at the proper time. The tributaries, lakes, and upper portions of the river constitute the breeding grounds and nurseries for the populations of salmon and steelhead trout which maintain the most important part of the fisheries of the Columbia. Some idea of the magnitude of this river system can be gained from figure 1 and the following quotation, "Columbia River and Minor Tributaries," Seventy-third Congress, first session, House Document No. 103:

> Columbia River is about 1,210 miles long. Four hundred twenty-five miles of its course is in the United States between the international boundary and the mouth of Snake River, and 332½ miles between the latter point and the Pacific Ocean. Its basin has an area of about 259,000 square miles, including about 39,000 square miles in Canada. About 64,000 square miles of the Columbia's basin above the Snake lies within the United States and embraces all of Washington east of the Cascade Range except the southeastern corner, northern Idaho, and Montana west of the Rockies. The basin of the Snake, the longest tributary of the Columbia (1,036 miles), covers about 109,000 square miles, embracing the extreme western part of Wyoming, southern Idaho, eastern Oregon, southeastern Washington, and small parts of Utah and Nevada. Below the mouth of the Snake the basin of the Columbia includes about 46,500 square miles in Washington and Oregon. About 27,000 square miles of this area lies between the Snake Basin and the Cascade Range, about 1,000 square miles through the Cascades and 18,500 square miles west of the Cascades. About 11,000 square miles of the last-mentioned area is in the basin of Willamette River.
>
> Three principal systems form the headwaters of the Columbia River: First, the Columbia River proper, which, rising in Columbia Lake in British Columbia near the international boundary, flows northwesterly for nearly 200 miles then turns abruptly to the west and south, circling Selkirk Range,

> and enters the United States at the northeastern corner of Washington; second, Kootenai River (spelled Kootenay in Canada), which also rises in British Columbia near the source of the Columbia proper, but flows in an opposite direction (southeasterly), paralleling the Continental Divide, enters the United States at the Idaho-Montana-British Columbia corner for a short curved course of 167 miles, and empties into Columbia River proper about 30 miles north of the international boundary after flowing through Lake Kootenay in Canada; and third, Clark Fork, which, with its tributaries, drains the strip of Montana between the Continental Divide and Idaho. Clark Fork rises in western Montana, flows northwest between the Continental Divide and Bitterroot Mountains, crosses the panhandle of Idaho and the northeast corner of Washington, and after a short course in British Columbia, empties into Columbia River very close to the international boundary and a short distance below the mouth of Kootenai River.
>
> Columbia River thence flows southwest and south through northeast and central Washington, is joined by Snake River at Pasco, Wash., and a short distance below Pasco turns west, forming the Washington-Oregon boundary to the Pacific Ocean.

The flow of the river is given by the following quotation (ibid.):

> * * *; extreme low-water flow above the mouth of Willamette (is) about 50,000, and maximum discharge of record about 1,160,000 cubic feet per second. The average summer freshet discharge due to melting snows in the upper watershed is about 660,000 second-feet. The mean low-water flow below the mouth of the Willamette is about 70,000 second-feet, exclusive of tide water. The effect of tides is observed on the Columbia to a point about 36 miles above Vancouver and on the Willamette to a point about 11 miles above Portland.

## CHRONICLE OF COLUMBIA BASIN

Since the development of the fisheries of the Columbia River has been in a great measure dependent on the civilization and progress of the area lying within its watershed, a brief discussion of the political history of this region should be of interest. In 1792 Robert Gray, a Yankee trader, sailed into the Columbia River which he named after his ship, thus giving the United States its first claim to that region. Two other Americans, Lewis and Clark, then made their overland journey in 1805–6 which resulted in the exploration of a good part of the Columbia River watershed and gave the United States a further title to that territory.

In 1808, 2 years after the return of Lewis and Clark, the Missouri Fur Co. was formed, which outfitted a party under the command of Alexander Henry, for the upper waters of the Missouri and Yellowstone Rivers. Since the hostility of the Blackfoot Indians prevented him from establishing a post on the upper Missouri as had been planned, Henry decided to cross the Rocky Mountains and establish a post on the headwaters of the Snake River. This he did in 1809, erecting a fort, the first building constructed by Americans for permanent occupancy west of the Rocky Mountains, on the bank of the tributary which now bears his name. This venture was of short duration and the post was abandoned the following year.

Also in 1808 a party of independent trappers set out from St. Louis in the same direction as Henry. In 1809 ten of these men crossed the Rocky Mountains and spent the summer hunting and trapping in the region at the headwaters of the Columbia. The following winter they spent some time in the Willamette Valley, returning to Missouri the following summer. Another and smaller party of hunters is said to have spent the winter of 1810 near the mouth of the Columbia, but none remained permanently in the country.

In 1809 Abiel and Jonathan Winship, who were engaged in trade between Boston and Canton, attempted to build a permanent station on the West coast where supplies could be stored and furs collected. They formed a corporation and dispatched the

*Albatross* from Boston in 1809, the vessel reaching Hawaii the following April and returning to the Columbia, entering that river May 26, 1810. It continued up the river to Oak Point, Oreg., where the party made its first attempt to establish a station. After several disappointments, they abandoned the venture and sailed away from the Columbia on July 18, 1810.

British fur traders came into the region when the Northwest Co. sent David Thompson into the upper part of the Columbia Valley where, in 1810, he established a trading post called Spokane House at the junction of the Little Spokane and Spokane Rivers. During 1811 Thompson explored the Columbia Valley from Kettle Falls to Astoria.

Americans continued their activities when, in March 1811, an expedition sent out by John Jacob Astor built a fort and trading post at the mouth of the Columbia which they called Astoria and sent a party to the confluence of the Okanogan and Columbia Rivers where they built a post for the purpose of competing with Spokane House. However, the war of 1812 forced the Americans out of the region and Astor's post at the mouth of the Columbia was sold in 1813 to the British who named it Fort George.

Soon after the close of the war of 1812 there was considerable dispute between the United States, Great Britain, Russia, and Spain over the ownership of the territory now constituting the northwestern portion of the United States. That part of the negotiation which took place between the United States and England was known as the "Oregon Question" or the "Northwestern Boundary Dispute." In 1818 these two Nations agreed to a joint occupancy of the territory for a period of 10 years Then, in 1819, Spain waived claim to the territory north of 42° north latitude in favor of the United States, and in 1824 Russia agreed to make no settlements south of 54° 40′ north latitude. The joint-occupancy agreement between Great Britain and the United States was renewed for an indefinite term in 1827.

The Hudson's Bay Co. absorbed the Northwest Co. in 1821 and Fort Vancouver was established in 1824–25 by John McLoughlin, their chief factor. In 1829 he built an establishment at the falls of the Willamette, where Oregon City now stands and, in 1832, his company built Nisqually House on Puget Sound. During this period the Hudson's Bay Co. attempted to discourage colonization in order that they might retain the territory as a fur trader's empire.

American settlers began to arrive in considerable numbers in the region south of the Columbia by 1841, and established a provisional government in 1843. Immigration from the eastern United States then increased very rapidly.

The boundary between the Oregon Territory belonging to the United States and the British possessions was definitely fixed by treaty in 1846. As originally constituted this territory included the present States of Oregon, Washington, Idaho, and parts of Montana and Wyoming. The Territory of Washington was created in 1853 and Oregon was admitted into the Union with its present boundaries in 1859. Washington and Montana were admitted as States in 1889. Idaho was organized as a Territory in 1863, at that time including, in addition to its present limits, Wyoming, Montana, and the portions of Nebraska, and North and South Dakota west of a northern prolongation of the eastern boundary of Colorado. Idaho and Wyoming entered the Union as States in 1890.

# SALMON FISHERIES OF COLUMBIA RIVER BASIN

The salmon fisheries of the Columbia are much more important than those for any other species both in value and in quantity of fish produced. As was previously stated, there are four species of salmon taken in commercial quantities in the Columbia. The fifth species of Pacific salmon indigenous to American waters, the pink salmon, *O. gorbuscha*, is never taken in significant numbers. Since the steelhead trout, *Salmo gairdneri*, are captured and utilized at the same time and in the same manner as the salmon, they are considered along with the salmon as contributors to the salmon fisheries.

The history of these salmon fisheries can well be divided into three major periods or divisions of time. First came that period before white men had invaded the Columbia Basin and the Indians carried on fishing operations in order to obtain food. Second, an intermediate period existed for a short time when the few white settlers and traders bartered with the Indians for fish, or caught them themselves, and either used the fish locally or made attempts to preserve them by salting or other means and export them for profit. Third, and last, there was a phase of intensive exploitation which started with the advent of the salmon-canning industry and has continued up to and including the present time.

## INDIAN FISHING

### EXTENT OF FISHERY

Much information concerning the Indian fishing operations is available in the accounts of the early explorers, such as Lewis and Clark, who entered the Columbia Basin by way of the Salmon River and journeyed down the Snake and the Columbia to its mouth in 1805–6 and David Thompson, a Canadian explorer and trader of the Northwest Co. who explored the main Columbia from its source in British Columbia to its mouth during the years 1807–11. Suckley and Cooper (1860) also comment upon the Indian fishery, as does Charles Wilkes in his "Account of the United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, and 1842."

From these and other sources it is evident that in their original state the Indians were quite numerous in the Columbia River drainage area and depended to no small extent upon fish, particularly salmon, as an important part of their food supply. These fish were not only consumed during the season when they were available, but were also dried and smoked, or made into pemmican in order that they could be stored away for future needs or transported easily.

When the Lewis and Clark expedition encountered the Salmon River, where it was accessible to salmon, they discovered Indians catching those fish and they were in frequent contact with scattered families and large villages whose primary activity at that time was salmon fishing. Apparently these people were found in large numbers during the remainder of their journey to the mouth of the Columbia.

On a rough sketch map showing the main Columbia from a short distance below the entrance of the Snake River to a considerable distance above the Wenatchee River, Clark has indicated the Indian fishing "establishments." This map includes the lower portion of the Snake River, most of the Yakima River system, the Wenatchee River, and part of another stream which may represent the Spokane River. In this area Clark has indicated approximately 100 Indian "fishing establishments," by which he probably meant villages or groups of lodges.

In 1 day's journey of 21 miles, just below the entrance of the Snake River into the Columbia, the explorers record passing 29 lodges, the inhabitants of which were engaged in catching and drying salmon. These lodges were rather large structures which might house as many as 5 or 6 families. Lewis and Clark comment several times on the large numbers of racks for drying salmon and the great quantity of dried and drying fish present in each of the lodges visited. Apparently salmon, berries, and roots were the main items in the diet of the Indians.

A little farther down the river they found the Indians making pemmican. This was dried salmon which had been pulverized and packed into basketlike sacks, lined with fish skins, which weighed from 90 to 100 pounds when filled. Lewis and Clark mention seeing 107 of these bags filled and stacked at one group of lodges. It probably required over 60,000 pounds of fresh salmon to fill this number of sacks with the dried product. The tribes which made pemmican not only stored it for their own use, but also traded it with the Indians of the lower river and coast for products and materials which they desired from that region.

The Indians were very numerous along this portion of the river and particularly large numbers were catching salmon and living in the vicinity of Celilo Falls and Cascade Rapids. However, the expedition was in almost constant touch with some of the natives through the entire course of their journey down the Columbia to its mouth, and all of these natives seemed to depend upon salmon as one of their principal sources of food.

When David Thompson made his exploration from Kettle Falls to the entrance of the Columbia he noted 20 families of Indians fishing for salmon near the junction of the Columbia and Snake Rivers and about 21 miles below Castle Rock, Oreg., he recorded 82 families fishing. He also mentions large numbers of natives fishing in the area adjacent to the Methow River and some taking fish in the San Poil River and the fact that there was a large fishing population at Kettle Falls. Thompson confirmed Lewis and Clark's observations as to the intensity of the Indian fishing from the forks of the Snake and Columbia to the mouth of the latter.

Captain Wilkes, of the United States Navy, visited Kettle Falls in 1841 and described the Indians' method of fishing with baskets at that location. He states that the Indians often took as many as 900 salmon during a 24-hour period. The run at Kettle Falls extends over a period of at least 60 days, so if 500 fish per day was their average catch, the Indians would have been taking some 600,000 pounds of fish annually in that location. Washington Irving quotes the early traders as estimating that the Indians at Salmon Falls on the Snake River took several thousand salmon in one afternoon by means of spears.

The falls on the Willamette River were another famous Indian fishing location and Capt. Charles Wilkes stated that at times 1 person took as many as 20 salmon in 1 hour with a dip net. He estimated the number of natives camped there at between 70 and 100. The same author also stated that there were often nearly 1,000 Indians at Spokane Falls during the height of the fishing season and that fishing was carried on there from June to sometime in October.

Without doubt salmon, either fresh or dried, was the chief single factor in the diet of the Indians of the Columbia Basin in their native state. Edible roots and plants were probably of next importance and sturgeon, trout, and other fishes were also utilized. Apparently these Indians were not expert hunters and before the white men supplied them with firearms they did not kill game in large quantities. However, they were able to secure some elk, deer, and antelope with their bows and stone-tipped arrows. One of their methods of pursuit was to surround a herd of animals and shoot with arrows those few which passed at close range as they escaped from the encircling ring of hunters. Small mammals and birds also formed occasional additions to the regular food supply.

From all of these accounts of the early settlers and explorers, there is an impression that the Indians in their original state were numerous in the Columbia River drainage area and the amount of salmon which they consumed was quite large. It is not possible to make an accurate estimate of the amount of salmon used by the Indians, but an approximation which is admittedly liable to a wide margin of error may serve to illustrate the possible magnitude of the Indian catch. In order to make such an estimate it is necessary to have information relating to the size of the original Indian population. Lewis and Clark believed that the Chinook Tribe alone numbered about 16,000, and early accounts indicate that other tribes in the Oregon country were numerous, so the Indian population at the beginning of the nineteenth century was probably near 50,000 (Carey, 1922).

However, as soon as the Indians came in contact with white men they began to diminish in number, because of their susceptibility to diseases contracted from the Caucasians. This condition became evident at a very early date, as is shown by the fact that Lewis and Clark state that several hundred Clatsops died of smallpox in about 1802. In 1824 and 1829 smallpox, and an ailment designated as ague fever, the exact nature of which is not now recognized, swept off thousands of these people. Competent authority estimates destruction of four-fifths of the native population in a single summer so that whole villages were eliminated and tribes were so reduced in numbers that they lost their identity and were absorbed by others. Even tribal languages became extinct in some instances. In 1847 measles proved fatal to many, and after the coming of the white men there seems to have been a succession of epidemic diseases. As a result of one of these, smallpox, the Cayuse Tribe was practically exterminated in 1847.

Carey (1922) also states, page 51:

> The Indians are said to have believed that Capt. Dominis, the American, brought the fever. Wilkes estimated the Indian population surviving in 1841 as less, rather than more than 20,000. Rev. Samuel Parker, who visited Oregon in 1835, says: "Since the year 1829 probably seven-eighths, if not as Dr. McLoughlin believes, nine-tenths, have been swept away by disease, principally by fever and ague."

In the Annual Report of the Commissioner of Indian Affairs, 1851, pages 214–217, an estimate of the number of Indians composing the tribes on the Columbia River is given. These tribes, exclusive of the Snakes who are entered merely as a "large tribe," are estimated at 8,280 individuals. Because of the rapid decrease of the Indian population after the appearance of the white men, it does not seem unreasonable to suppose that this figure of 8,280 individuals surviving in the Columbia River tribes in 1851 represented no more than one-sixth of the Indian population on the Columbia in their primitive state. On this basis Carey's previously given estimate of 50,000 Indians at the end of the nineteenth century does not appear unreasonable, since 50,000 is approximately 6 times 8,280, and it will be used as the best available estimate of the population utilizing the Columbia River salmon fisheries in primitive times.

During at least 6 months of the year the salmon are present in significant quantities in the river and its tributaries, so that the Indians could have taken and consumed them in large numbers while they were fresh. They also dried and stored the salmon for use during the winter months when the fish were not numerous. The tribes in the neighborhood of Celilo Falls and The Dalles also made pemmican of the salmon and traded it to tribes less fortunately situated for the catching and preserving of fish.

Therefore, it appears to be well within the realms of probability that these Indians had an average per capita consumption of salmon of 1 pound per day during the entire year. If such were the case, and the population were 50,000 people, their annual salmon catch would have been about 18,000,000 pounds per year. During 1933 the commercial catch of all species of salmon and steelhead trout on the Columbia River was approximately 26,000,000 pounds; therefore, it is evident that in primitive times the Indians may well have taken an annual catch which was a very significant proportion of the commercial catch of today.

Even though the primitive Indian catch might have been of some such magnitude as that estimated above, it did not represent as great a proportional strain on the spawning population as its relationship to the present catch would indicate. This is true because it must be remembered that under present conditions many miles of spawning streams have been cut off by dams so that they are no longer available to the migratory fish, that irrigation diversions take an enormous toll of the young migrants when they are on their way to the sea, and that pollution and other changed conditions have made many streams less suitable for salmon. However, discontinuance of the primitive Indian catch because of the great decrease in the number of Indians may be one of the factors which helps to explain the ability of the Columbia River salmon to continue to produce a catch as large as they have, even under increasingly unfavorable conditions.

## METHODS AND GEAR

According to the observations of the early explorers, traders, and trappers, the Indians were well equipped to catch large quantities of fish. These natives employed a singularly effective method for taking salmon and other fish in small tributary streams. This was the placing of obstructions or weirs across the streams so that the fish either ascending or descending the streams would be stopped in their migrations. Some of the weirs were supplied with basket traps, which acted much the same as fyke nets. These were placed so that the fish were led into them by the weirs. Other weirs merely served as obstructions to halt the fish so that they could be caught by means of dip nets or small seines as they attempted to pass. The weirs were constructed of willows or other flexible materials woven together and supported by poles and rough tripods, or fallen trees.

A description of two weirs observed by Lewis and Clark (vol. III, pp. 6–7 and vol. IV, p. 337) follows:

> This morning early Cap$^{t}$ resumed his march; at the distance of five miles he arrived at some brush lodges of the Shoshones inhabited by about seven families. here he halted and was very friendly received by these people, who gave himself and party as much boiled salmon as they could eat; they also gave him several dried salmon and a considerable quantity of dryed chokecherries. after smoking with them he visited their fish wear (weir) which was about 200 y$^{ds}$. distant. he found the wear extended across four channels of the river which was here divided by three small

islands. three of these channels were narrow, and were stoped by means of trees fallen acress, supported by which stakes of willow were driven down sufficiently near each other to prevent the salmon from passing. about the center of each cilindric basket of eighteen or 20 feet in length terminating in a conic shape at it's lower extremity, formed of willows, was opposed to a small apperture in the wear with it's mouth up stream to receive the fish. the main channel of the water was conducted to this basket, which was so narrow at it's lower extremity that the fish when once in could not turn itself about, and were taken out by untying the small ends of the longitudinal willows, which form the hull of the basket. the wear in the main channel was somewhat differently contrived. there were two distinct wears formed of poles and willow sticks, quite across the river, at no great distance from each other. each of these, were furnished with two baskets; the one wear to take them ascending and the other in decending. in constructing these wears, poles were first tyed together in parcels of three near the smaller extremity; these were set on end, and spread in a triangular form at the base, in such manner, that two of the three poles ranged in the direction of the intended work, and the third down the stream. two ranges of horizontal poles were next lashed with willow bark and wythes to the ranging poles, and on these willow sticks were placed perpendicularly, reaching from the bottom of the river to about 3 or four feet above it's surface; and placed so near each other, as not to permit the passage of the fish, and even so thick in some parts, as with the help of gravel and stone to give a direction to the water which they wished. the baskets were the same in form of the others. this is the form of the work, and disposition of the baskets. (See fig. 2a.)

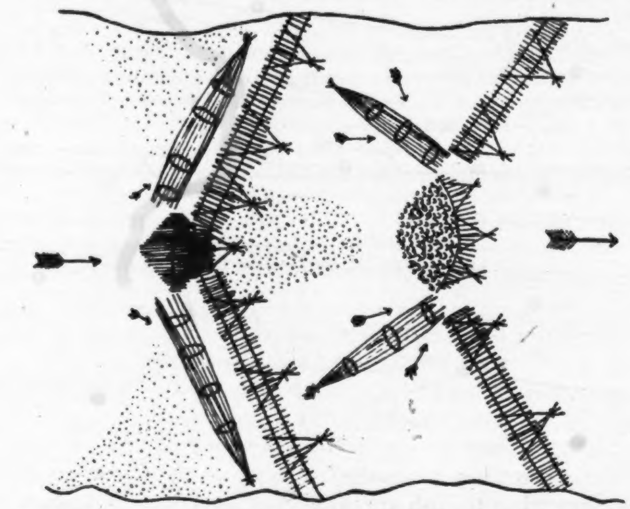

FIGURE 2.—Type of salmon-catching weir that Lewis and Clark found the Shoshone Indians using

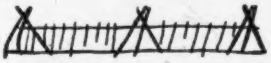

FIGURE 2a.—Type of weir commonly used by the Indians in the tributaries of the Columbia River.

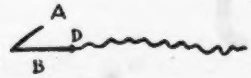

FIGURE 2b.—Type of hook used by the Chinook and Clatsop Indians along the lower Columbia.

(Drawings are from the "Original Journals of the Lewis and Clark Expedition.")

The weir next described was located in the Walla Walla River:

This weare consists of two curtains of small willows wattled together with four lines of withes of the same materials extending quite across the river, parralal with each other and about 6 feet asunder. those are supported by several parrelals of poles placed in this manner (See fig. 2b) those curtains of willows is either roled at one end for a fiew feet to permit the fish to pass or are let down at pleasure. they take their fish which at present are a mullet only of from one to 5 pounds wt with small seines of 15 or 18 feet long drawn by two persons; these they drag down to the wear and rase the bottom of the seine against the willow curtain. they have also a small seine managed by one person, it bags in the manner of the scooping nets; the one side of the net is confined to simicircular bow of half the size of a mans arm and about 5 feet long, the other side is confined to a strong string which being attached to the extremities of the bow forms the cord line to the semicurcle

Apparently these weirs were widely used by the natives since they are mentioned in many of the early accounts of the region. The Little Spokane River, the Walla

Walla River, tributaries of the Snake River, and the San Poil River are all mentioned as localities where this type of gear was employed. When used in salmon fishing such methods must have been extremely destructive, since, by stopping the ascent of all salmon up a stream, all spawning in that tributary would be prevented. If such a course were followed for several years in succession, an entire cycle of spawning would be missed and because of the fact that almost all salmon return to their parent stream, the entire run to that particular tributary would be destroyed and would not return until built up by strays coming in from other populations. This would be an extremely slow and uncertain process, since the amount of straying by chinook and blueback salmon is small.

An apparently unique method for taking salmon and steelheads was followed by the natives at Kettle Falls. This is described very well by Wilkes (1845) as follows:

> There is an Indian village on the banks of the great falls, inhabited by a few families, who are called "Quiarlpi" (basket people), from the circumstance of their using baskets to catch their fish (salmon). The season for the salmon fishery had not yet (in June?) arrived, so that our gentlemen did not see the manner of taking the fish; but, as described to them, the fishing apparatus consists of a large wicker basket supported by long poles inserted into it and fixed in the rocks. The lower part, which is of the basket form, is joined to a broad frame spreading above, against which the fish in attempting to jump the falls strike and are thrown back into the basket. This basket during the fishing season is raised three times in the day (24 hours), and at each haul not unfrequently contains 300 fine fish. A division of these takes place at sunset each day under the direction of one of the chief men of the village, and to each family is allotted the number it may be entitled to; not only the resident Indians, but all who may be there fishing, or by accident, are equally included in the distribution.

The statement that all of the fishing is done with 1 basket is open to question. The salmon taken at Kettle Falls average some 20 pounds in weight, and if 300 were taken in 1 haul, the basket would be carrying a load of about 6,000 pounds. The Indians at Kettle Falls continue to fish by the same method at the present time, except that their baskets are now made of iron and wire netting instead of willow or other woods. There are a number of locations where they place the baskets and there are always several in operation during the time when the fish are running at the falls. Therefore, it seems probable that the Indians have always used more than 1 basket and fished several locations at the same time.

Spears were a common and widely used means of capturing salmon and steelheads, and were used in small tributaries or wherever rapids or falls made the fish expose themselves so that they could be speared. One type of spear used was very effective for taking large and vigorous fish, such as salmon, and is still used in some places with much the same design, but with iron substituted for the native materials used in the head. This is what is known as a "slip point" spear. As originally constructed by the Indians, it consisted of a straight piece of elk or deer horn, about 7 inches long, pointed, and mounted on the end of a long willow pole. A small piece of bone was then fashioned into a very sharp point with either one or two barbs. This small point was hollowed and fitted snugly over the long piece of horn fitted to the pole. A cord was then made fast to the small point and secured firmly to the pole about 2 or 3 feet back from the head. Enough slack was left in the cord so that the small point could be removed without difficulty. When ready for use, the small point was mounted on the longer piece of horn. When a salmon was struck the small point was usually forced completely through the fish. The point would then become dislodged from the rest of the spear and turn sidewise with the result that it could not be pulled out through the wound. Since the point was attached to the wooden shaft of the spear by a cord, the salmon could then be played and landed with the short line and stiff pole. Such an implement has a considerable advantage over a spear with the head attached immovably to the shaft, since a large fish is apt to either tear away from the spear or break the shaft when one of that type is used.

Hooks were also used by the primitive inhabitants of the Columbia Basin. There is evidence that they were baited and used for catching sturgeon and for trolling for salmon in the lower portion of the river. In this type of fishing, small herring or smelt were put on the hook attached to a line having a stone sinker. The bait was then pulled behind a canoe, sinking some 8 to 10 feet below the surface. Lewis and Clark describe a type of native hook and other gear in the following quotation (vol. III, pp. 350–351):

> The Clatsops Chinnooks &c. in fishing employ the common streight net, the scooping or diping net with a long handle, the gig, and the hook and line. the common net is of different lengths and debths usually employed in taking the sammon, Carr (cherr) and trout in the inlets among the marshey grounds and the mouths of deep creeks the skiming or (s)cooping net to take small fish in the spring and summer season; the gig and hook are employed indiscriminately at all seasons in taking such fish as they can procure by their means. their nets and fishing lines are made of the silk-grass or white cedar bark; and their hooks are generally of European manufactory, tho' before the whites visited them they made hooks of bone and other substances formed in the following manner A C, and (see fig. 2c) C. B. are two small pieces of bone about the size of a strong twine, these are flattened and leveled off of their extremities near C. where they are firmly attached together with sinues and covered with rosin. C A. is reduced to a sharp point at A where it is also bent in a little; C B. is attached to the line, for about half it's length at the upper extremity B. the whole forming two sides of an accute angled triangle.

These same explorers observed an Indian boy catching "chubs" near the mouth of the Walla Walla River with a hook which was merely a bone sharpened at either end with the line fastened at the middle. After the bait and sharpened bone had been swallowed by the fish, a jerk on the line would turn it at right angles to the line and no doubt it would serve as a fairly effective hook.

Nets were widely and extensively employed by the Indians to catch salmon, trout, eulachon, and other fishes. Apparently these nets fell into two general classifications, seines and scooping or dipping nets. The dip nets were employed at locations such as Celilo Falls and the falls of the Willamette at Oregon City, where the salmon are forced to seek eddies and restricted channels. These nets were merely hoops, some 3 to 5 feet in diameter, supporting a bag of mesh webbing and attached to the end of a long pole. It is recorded that some of these nets were arranged so the mesh would slip on the hoop and close the opening of the net after a fish was caught.

Capt. Charles Wilkes (1852, vol. II, pp. 184–185) gives a very interesting account of the dip-net fishing at the falls of the Willamette where Oregon City now stands. He describes it as follows:

> At the time of our visit to the falls of Willamette, the salmon fishery was at its height, and was to us a novel as well as an amusing scene. The salmon leap the fall; and it would be inconceivable, if not actually witnessed, how they can force themselves up, and after a leap of from ten to twelve feet retain strength enough to stem the force of the water above. About one in ten of those who jumped, would succeed in getting by. They are seen to dart out of the foam beneath and reach about two-thirds of the height, at a single bound: those that thus passed the apex of the running water, succeed; but all that fell short were thrown back again into the foam. I never saw so many fish collected together before; and the Indians are constantly employed in taking them. They rig out two stout poles, long enough to project over the foaming cauldron, and secure their larger ends to

> the rocks. On the outer end they make a platform for the fisherman to stand on, who is perched on it with a pole thirty feet long in hand, to which the net is fastened by a hoop four feet in diameter; the net is made to slide on the hoop, so as to close its mouth when the fish is taken. The mode of using the net is peculiar: they throw it into the foam as far up the stream as they can reach, and it being then quickly carried down, the fish who are running up in a contrary direction are caught. Sometimes twenty large fish are taken by a single person in an hour; and it is only surprising that twice as many should not be caught.

This mode of fishing is followed at the present time by Indians at Celilo Falls and at other locations on the Columbia. It is also common to several other river systems.

Eulachon and other small fish were captured with small, shallow dip nets. These were probably the type referred to by Lewis and Clark as "scooping nets."

The natives displayed a high degree of ingenuity and efficiency in making their nets, and the materials used were quite varied. Both the inner bark of the white cedar and the long surface roots of spruce were used in the manufacture of the webbing and lines. The spruce roots were split and soaked in water and then split and soaked again until they were of sufficient smallness and pliability to be woven into cords and webbing.

According to all of the information available, the best nets were made from the fibers of a plant variously designated as "wild hemp," "wild flax," or "silk grass." Milkweed is also mentioned as a source of net material, but whether or not this was the same plant as the silk grass appears to be doubtful. Silk grass grew only in the region east of the Cascade Mountains and was bartered by the natives of that area to the Indians living on the lower Columbia and along the coast.

The large Indian nets were constructed and operated in much the same manner as the seines now used on the Columbia River. They consisted of a single wall or thickness of net or webbing fastened to a lead line at the bottom and a cork line at the top, with appropriate lines attached for hauling the nets. The lead lines were usually weighted with flat, circular stones, some 4 to 5 inches in diameter, and with holes bored through their centers through which the line passed. This was for the purpose of keeping the lead line on the bottom as the net was pulled in. The cork line had pieces of dried, dead cedar, or some other light wood attached to it to keep it afloat and from sagging down toward the lead line. In some cases dry cedar sticks, about 4 feet long and 1 inch in diameter were used as floats. These pieces were attached to the cork line by only one end with the result that when the cork line sank below the surface the cedar sticks would float vertically in the water. Then, as the net was pulled in, its movement and the action of the current would cause the pieces of wood to thrash about and keep the fish from swimming out over the top of the net.

In operating such a net, places were selected where the salmon congregated because of current conditions. Locations where the bottom was fairly smooth and the slope of the shore not too abrupt were also necessary. One end of the net was kept on shore and the other taken out in a canoe and circled about the area containing the fish before being brought back to shore. Both ends were then pulled in, care being taken to keep the lead line on the bottom and slightly ahead of the cork line. As the operation was completed the fish were trapped in the constricting net and finally pulled out on the beach. Some of these nets were as large as 8 feet deep and 50 fathoms in length and must have been very efficient pieces of fishing gear. They were used in the main Columbia from Kettle Falls to its mouth and for a considerable distance up the Snake River from its confluence with the Columbia.

There is some evidence to the effect that the Indians tied nets out in the streams so that the fish became entangled or gilled in them. However, no definite information is available concerning that type of fishing.

The native people of the Columbia depended upon canoes, when fishing and traveling, to much the same extent that the plains tribes utilized horses in pursuing buffalo and other game and in making their migrations, and, since the canoes were such an important part of their fishing equipment, a brief description of them is here given. In the region from Celilo Falls to the mouth of the Columbia all of the canoes were fashioned from solid pieces of timber. These craft were usually hewn from white cedar or fir and varied in length from 15 to 50 feet. The larger canoes were confined to the lower tidewater portion of the river and could carry from 8,000 to 10,000 pounds, or 20 to 30 persons. Even the smallest ones were made with an overhang or flare at the gunwales to prevent spray or waves from washing aboard. All of them were provided with braces fashioned from round poles, varying in size and number according to the length of the canoe, placed crosswise near the gunwale and fastened in with thongs run through holes in the sides. The cross braces were also useful in lifting or moving the boats.

The larger boats had combs or peaks at bow and stern and many of them were ornamented with carved figures both fore and aft. These figures were carved from the same log as the rest of the craft with additional pieces fitted on by means of tenons and mortices. Such canoes were very highly prized by the natives.

It is evident that the Indians possessed fishing gear and knowledge of fishing methods which were efficient, even when compared to modern methods. When we consider their numbers and the importance which fish, and salmon in particular, held in their diet, it must be admitted that their annual take of salmon was probably considerable.

## INTERMEDIATE PERIOD

As soon as the first traders and settlers penetrated the Columbia Basin, they began taking salmon for their own use and trading for them with the Indians. At first the fish were used by the local inhabitants only, and the amount consumed was insignificant. However, this small beginning marked the start of the utilization of the fisheries by the white men and as the Indians declined in number the white men increased. At that time there occurred a period of transition, lasting some 40 years, during which the whites were replacing the Indians in the fisheries of the Columbia. The actual toll taken by the expanding fisheries in this period was small, but the developments are of interest since they were the beginning of what has become a large industry.

The early traders obtained fish for their own use through barter with the Indians and by fishing themselves. Thompson, and Lewis and Clark all mention this frequently, as when Thompson states that at the time of his visit to Fort Astoria the traders had not been able to set a standard of barter for salmon with the Indians. Approximately 20 years later, or shortly after 1830, a standard of barter had been reached and salmon were being purchased from the Indians and salted down for local use and a small amount of trade. Indian women were often hired to cut off the heads, split the fish, and remove their backbones.

The first operations of which there are any record, and which resulted in fish being used commercially outside of the local territory, occurred when Capt. John Dominis, commanding the brig *Owyhee*, of 200 tons burden, visited the river in 1829 for the purpose of fur trading. He spent 2 summers trading with the Indians at Deer Island and wintered at Milton, a small hamlet just above St. Helens. While at that place he conceived the idea of packing a few salmon and taking them back to eastern markets. He accordingly began operations and used the Jamaica rum hogsheads, in which hardtack and other provisions had been packed, for containers. The fish were purchased from the Indians who were paid 3 leaves from a twist or knot of tobacco for each fish. He packed some 50 or 58 of these casks with salmon and when they arrived in Boston the fish were sold for 10 cents per pound (Astoria Daily Budget, August 29, 1894).

The first American to go to the Columbia with the intention of establishing a salmon fishery in connection with fur trading was Capt. Nathaniel J. Wyeth, of Massachusetts. He crossed the continent overland in 1832, and at the same time dispatched a vessel loaded with supplies which was to proceed to the Columbia via Cape Horn. This ship was lost and never heard from after sailing. However, Wyeth arrived safely and established a station at Fort Hall on the Lewis River, a lower tributary of the Columbia. He returned to Boston in 1833 and sent another vessel, the *May Dacre*, freighted with trading goods and supplies around Cape Horn to the Columbia. This ship arrived safely and Wyeth again crossed overland with a company of 200 men. He established a fort and salmon fishery at the lower end of Wappatoo (now Sauvies) Island at the mouth of the Willamette River and not far from where the city of Portland, Oreg., now is.

Since the Hudson's Bay Co. was willing and able to pay the Indian fishermen more for their fish, Wyeth's salmon fishery did not prove successful and the *May Dacre* sailed in 1835 with only a half cargo of fish. In that same year Captain Wyeth became convinced that he could not meet the powerful competition of the Hudson's Bay Co. and discontinued his establishments at both Lewis River and Wappatoo Island. He then returned to Massachusetts. A part of the cargo of the brig *May Dacre* brought $12 a barrel at the Hawaiian Islands, and $17 a barrel at Boston.

Columbia River salmon were introduced to the markets of Honolulu, Valparaiso, and London by the Hudson's Bay Co. at an early date. A group of the chief members and stockholders of the Hudson's Bay Co. associated themselves under the firm name of Pelly Simpson & Co., in London, with a capital of more than $15,000,000. It was through this firm that the agricultural and commercial operations of the English were carried on at Puget Sound, the Columbia River, California, and the Hawaiian Islands. The Honolulu agency of this company was established in 1832. During that period many whalers touched at the islands and consequently there was a good market at that place for English goods, Columbia River salmon, sawn lumber from the Columbia mills, and the surplus produce of Fort Vancouver and its dependencies.

In August 1840 Capt. John H. Couch, in command of the brig *Maryland*, which belonged to Cushing & Co., of Newburyport, Mass., arrived in the Columbia River. The vessel took a few salmon and then returned to Massachusetts. On April 2, 1842, Captain Couch returned to the river with another boat, the *Chenamus*, named after a chief of the Chinooks. With his cargo of goods he established himself at the present site of Oregon City, Oreg., and became the proprietor of the first American trading house in the Willamette Valley. John McLoughlin, chief factor of the Hudson's Bay Co., had built an establishment at the falls of the Willamette River in 1829. Couch also established a fishery at Pillar Rock, on the Columbia River, where he salted salmon.

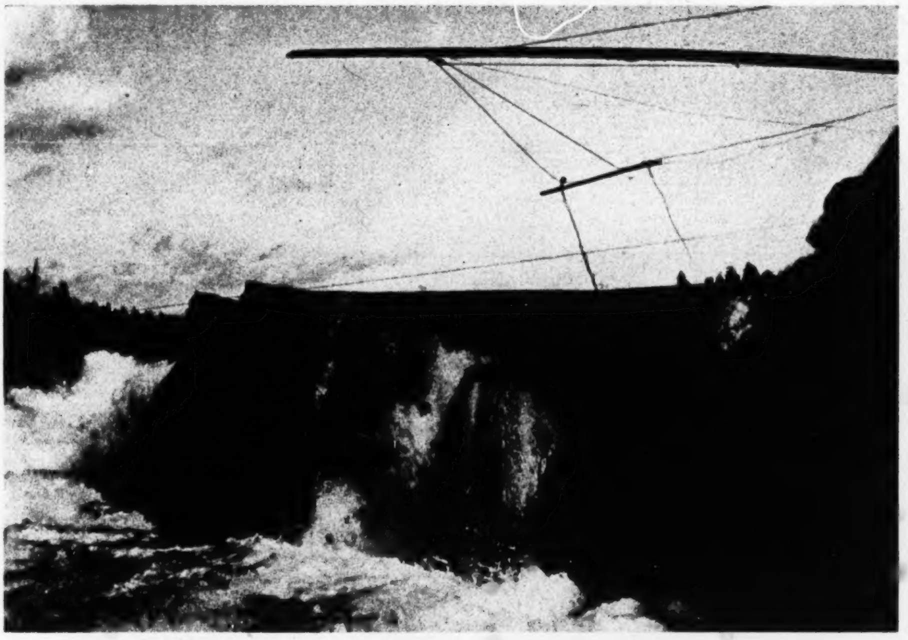

FIGURE 3.—Indian jump basket, Kettle Falls.

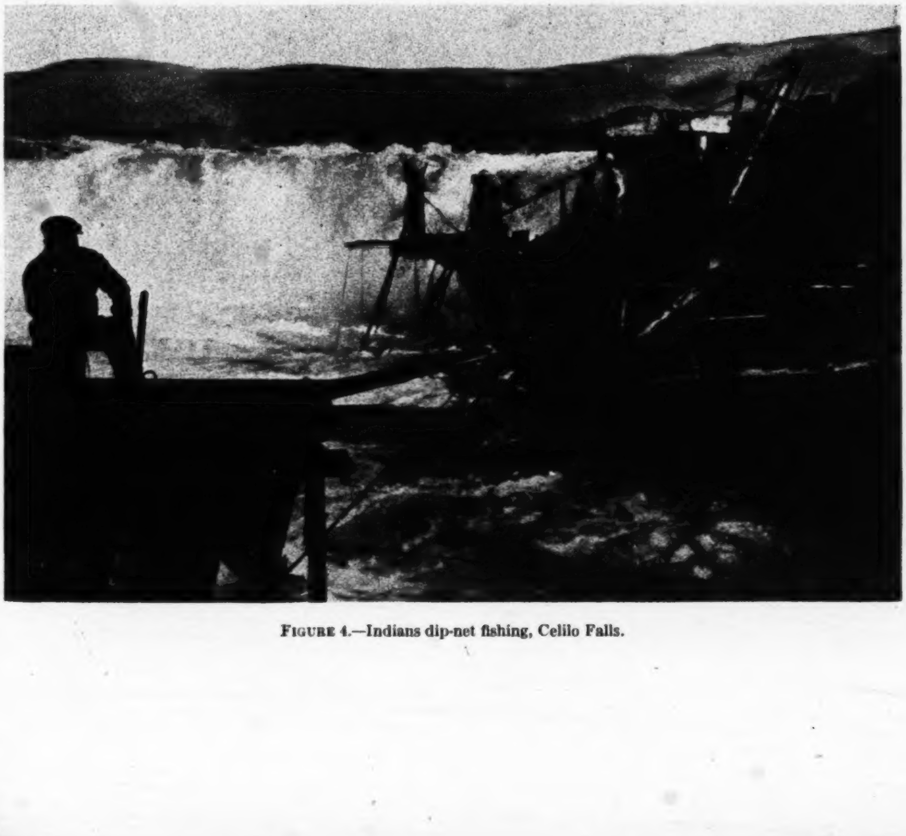

FIGURE 4.—Indians dip-net fishing, Celilo Falls.

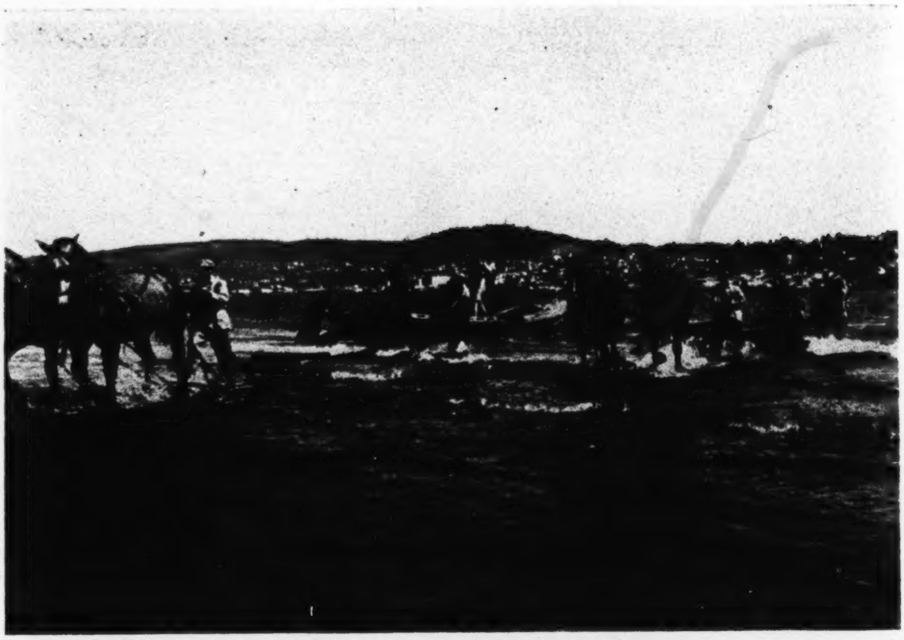

FIGURE 5.—Pulling in a haul seine, near Astoria, Oreg.

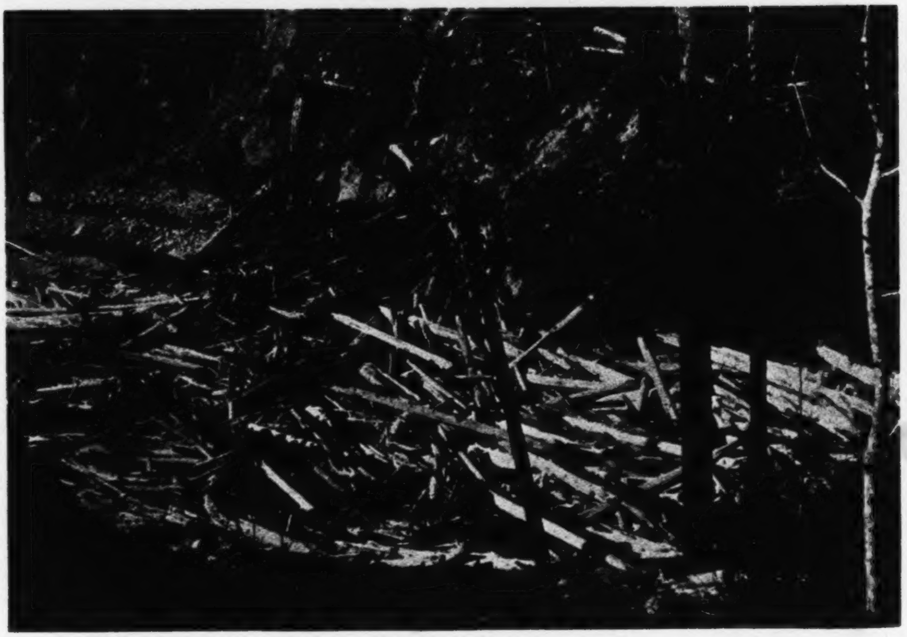

FIGURE 6.—Log dam on an upper tributary, showing the ill effects of logging operations.

The brig *Pallas*, Captain Sylvester, arrived in the Columbia in September 1843, with a cargo of goods assigned to Cushing & Co. The brig took away 300 to 400 barrels of salmon. Cushing & Co. next established a small fishery between Astoria and Tongue Point in 1844, from which the *Chenamus* took a cargo in the following year. Captain Sylvester took the ship on the return to the east coast, and since its name does not appear after this it may have been lost.

Captain Spaulding, of the *Lausanne*, made an entry in his journal in 1841 to the effect that the Hudson's Bay Co. took about 1,000 barrels of salmon per annum, 300 barrels of which McLoughlin gave away every winter to keep the Indians alive. Van Tramp and Wilkes also mention that the Hudson's Bay Co. put up a large quantity of salmon yearly.

A ship commanded by a Captain Chapman entered the river in 1842 for the purpose of trading and fishing. There is no record concerning success of the fishing operations, but it is told that liquor was traded to the Indians which resulted in some trouble and bloodshed.

Sir George Simpson, in a letter to the officers of the Hudson's Bay Co. dated Honolulu, March 1, 1842, stated that the company's salmon fisheries which had been conducted on a limited scale at Forts Vancouver and Langly, were deserving of more attention as a source of trade. He observed that the demand in the markets of the United States and China promised to be very great. At that time a barrel of 180 pounds brought from $10 to $12 at the Hawaiian Islands.

The *Toulon* made a voyage from the Columbia to the Hawaiian Islands in the spring of 1846, returning with a cargo on June 24. This vessel continued to run to the islands for several years and probably carried salmon on some of its trips since it usually formed a part of out-bound cargoes.

By this time Columbia River salmon was known in many parts of the world. Whereas the earliest traders had taken a few barrels as an experiment, many of the vessels now leaving the river took barrels of salted salmon as a part of their regular cargoes. The coasters also carried salmon to a market which had developed in California, as is shown by the following quotation from the Californian (San Francisco, Calif.) of November 17, 1847:

> The brig *Henry*, Captain Kilbourn, arrived yesterday from the Columbia River, with a cargo of lumber, flour, salmon, beef, potatoes, butter, cheese, cranberries, turnips, cabbage and onions, also a small invoice of almanacs adapted to the meridian of Monterey.

It can be seen from the foregoing that the Hudson's Bay Co. and Pelly Simpson & Co. played an important part in the introduction of Columbia River salmon into the markets of the world, that American traders handled increasing amounts of the salmon, and that the salmon became a regular article of commerce from the river. After 1846 the British interests withdrew from the river and the development of the fisheries was left entirely in the hands of the Americans.

In the early fifties permanent residents of the region began to enter into the fisheries, catching and salting salmon for local consumption. As early as 1853 [3] two men, Hodgkins and Sanders, began to fish with gill nets for salmon below Oak Point. Also, in that same year, these two men and Mr. Jotham Reed built two fish traps near Oak Point. These first traps were not constructed strongly enough to withstand the freshets and were washed out, but in the fall of 1854 they built a trap which was very successful. Mr. P. J. McGowan packed salted salmon in the lower portions of the river during the fifties, and Suckley & Cooper (1860) wrote:

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[3] Victor (1872) gives the date as 1851.

> In 1853 and 1854 large quantities of salmon were salted for market at the fisheries near the mouth of the Columbia, and at the Cascades, about 150 miles above.

Commercial fishing on the Columbia was beginning to take on the aspect of an industry by 1861, and in that year H. N. Rice and Jotham Reed began packing salted salmon in barrels at Oak Point, 60 miles below Portland, Oreg. The first season's pack amounted to 600 barrels. This product met with a limited demand, but sold for $12 per barrel. In 1862, 800 barrels were packed; in 1863, 1,000 barrels, at $11; and in 1865 the firm packed 2,000 barrels, but during this year a number of other firms became engaged in the business, the market was oversupplied and as a result the price fell to $6 per barrel. There is no available record of the pack of these firms in succeeding years, and nothing definite can be learned concerning their continuance in the business. The assumption is that many of them hastily abandoned the enterprise as unprofitable. In these early years the fish were caught almost wholly by Indians, who were usually paid about $40 per month. P. J. McGowan paid 10 cents a fish in the early sixties. Some of the early pack went to the Hawaiian Islands and no great quantity was shipped to the east coast at that time because of the loss caused by the high temperatures when passing through the equatorial zone. After the advent of canning, the salt-salmon business decreased rapidly.

## MODERN SALMON INDUSTRY

These few attempts to establish a trade in salted salmon and a local commerce for the fresh and salted fish were evidently operations of small magnitude and the number of fish consumed by them was insignificant. Indeed, there is little doubt but that the amount of salmon used by the white settlers and traders from 1820 to 1865 by no means equaled the falling off of the Indian catch which was occasioned by the great decrease in the Indian population taking place within that period. Therefore, it is not improbable that there was less fishing strain on the salmon populations of the Columbia during the period from about 1835 to 1865 than at any other time in their history. If this were the case, the salmon of the Columbia may have been more abundant during the few years immediately before the advent of the canning industry in 1866 than at any other time within our knowledge. In fact it was not until this development took place that these fisheries began to expand into any such industry as we know today.

The events which led to the establishing of the first salmon cannery on the Columbia began at the town of Washington, Yolo County, Calif. This town is directly across the Sacramento River from the city of Sacramento and it was there that Hapgood, Hume & Co., in 1864, set up the first salmon cannery in the United States. During their first year they packed 2,000 cases of salmon. However, since they were pioneers in an entirely new field, their troubles were many and vexatious. Their tools and apparatus were very crude and they had no means of testing cans for leaks and, as a consequence, lost about half of their first pack through spoilage caused by leaky cans. Also, many of the cans were so imperfectly made that they burst while being cooked.

Their product was, of course, entirely new and unknown, and at first they experienced a great deal of difficulty in disposing of it. However, a merchant in San Francisco found a market for it at a good price so they were encouraged enough to go ahead with their project.

Because of the scarcity of salmon in the Sacramento River it was not possible to increase their pack to any great extent. Therefore, William Hume went to the Columbia River to investigate its possibilities as a field for his cannery operations. He was favorably impressed and it was decided to establish a cannery at Eagle Cliff in what is now Wahkiakum County, Wash. The building was constructed, the machinery installed and all of the gear made ready so that in 1866 a pack of 4,000 cases of 48 cans each was put up.[3]

## DEVELOPMENT OF SALMON CANNING

The industry thus initiated by the pioneers developed with amazing rapidity. By 1873 there were 8 canneries and 10 years later the number had increased to 39. The largest gain in number from one year to the next occurred from 1876 to 1877 when the number of canneries operated expanded from 17 to 29. The period from 1883 to 1887 with from 39 to 37 in operation, marked the peak in the number of canneries on the Columbia and shortly after that time they dropped off rapidly. In 1888 the number was 28 and by 1890 only 21. Since that time they have fluctuated in number from 13 to 24 with the exception of 1935 when only 10 canneries operated, which was the lowest level for the canneries in point of number since 1873.

The rapid increase of the canneries until 1882 is easily understood. Salmon canning on the Columbia was an entirely new industry with an apparently inexhaustible supply of the raw materials readily at hand and easily obtained. The prices received for the finished product were good and the business offered a quick profit from a moderate investment. After this rapid expansion, several factors tended to cause the decrease in the number of canneries, which took place after 1887. Naturally the great increase in the number of plants operating resulted in a large pack. This greatly augmented production, together with competition from cheaper fish, such as steelheads and salmon from other districts, which began to appear in the markets tended to lower prices. Also, as the industry expanded, canneries were compelled to compete with one another for fish, thus causing a sharp increase in the price paid to the fishermen for salmon. In 1878 the fishermen were paid 25 cents per fish and in 1879, 50 cents. By 1882 the price was up to 75 cents, and in 1890 the fishermen received $1 until June 1, and 75 cents thereafter. All of these prices were for chinook salmon.

During this same period the packers also began to note that the chinook salmon were not as abundant as they once had been and expressed the first fears of a shortage of fish and depletion of the runs on the Columbia. All of these circumstances, which tended to make it difficult and costly for the cannery operators to secure the fish from the fishermen and to lower the price of their product, caused many of them to sell out their businesses and seek other fields.

By 1908 the number of canneries was reduced to 14, but the World War, which caused great demand and high prices for foodstuffs, improved market conditions so that by 1919 the canneries numbered 21. The recent depression was a primary cause of a decline which resulted in only 10 canneries being operated in 1935 in contrast to 21 in 1930.

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[3] R. D. Hume, Salmon of the Pacific Coast, states that this pack was made in 1867, but since all other authorities give 1866 as the year in which the first pack was made on the Columbia, that date is assumed to be correct.

It should not be assumed that the number of canneries in each year, shown in table 1, is an accurate index of the packing capacity of the plants on the Columbia River. Such a conclusion would be erroneous for several reasons. In some instances, as canneries went out of business they were absorbed by purchase or consolidation by some of those still carrying on, thus increasing the size and capacity of those remaining. Also there have been many important improvements in the mechanics of packing salmon so that canneries now have many times the capacity common to those operating in the early 1880's. Cobb (1931, p. 518) states:

> When salmon canning was in its infancy a pack of from 150 to 200 cases was a good days work. Now it is not an uncommon occurrence for a cannery to turn out from 2,500 to 4,000 cases in one day, and there are a number which have even greater capacity.

TABLE 1.—*Pack of canned salmon on the Columbia River, 1866 to 1936, inclusive*[1]

| Year | Number of canneries operated | Chinook | | Blueback | | Silver | | Chum | | Steelhead | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cases | Value | Cases | Value | Cases | Value | Cases | Value | Cases | Value | Cases | Value |
| 1866 | 1 | 4,000 | $64,000 | | | | | | | | | 4,000 | $64,000 |
| 1867 | [2] 1 | 18,000 | 288,000 | | | | | | | | | 18,000 | 288,000 |
| 1868 | 2 | 28,000 | 392,000 | | | | | | | | | 28,000 | 392,000 |
| 1869 | 4 | 100,000 | 1,350,000 | | | | | | | | | 100,000 | 1,350,000 |
| 1870 | 5 | 150,000 | 1,800,000 | | | | | | | | | 150,000 | 1,800,000 |
| 1871 | 6 | 200,000 | 2,100,000 | | | | | | | | | 200,000 | 2,100,000 |
| 1872 | 6 | 250,000 | 2,325,000 | | | | | | | | | 250,000 | 2,325,000 |
| 1873 | 8 | 250,000 | 2,250,000 | | | | | | | | | 250,000 | 2,250,000 |
| 1874 | 13 | 350,000 | 2,625,000 | | | | | | | | | 350,000 | 2,625,000 |
| 1875 | 14 | 375,000 | 2,250,000 | | | | | | | | | 375,000 | 2,250,000 |
| 1876 | 17 | 450,000 | 2,475,000 | | | | | | | | | 450,000 | 2,475,000 |
| 1877 | 29 | [3] 380,000 | 2,052,000 | | | | | | | | | 380,000 | 2,052,000 |
| 1878 | 30 | 460,000 | 2,300,000 | | | | | | | | | 460,000 | 2,300,000 |
| 1879 | 30 | 480,000 | 2,640,000 | | | | | | | | | 480,000 | 2,640,000 |
| 1880 | 35 | 530,000 | 2,650,000 | | | | | | | | | 530,000 | 2,650,000 |
| 1881 | 35 | 550,000 | 2,475,000 | | | | | | | | | 550,000 | 2,475,000 |
| 1882 | 35 | 541,300 | 2,600,000 | | | | | | | | | 541,300 | 2,600,000 |
| 1883 | 39 | 629,400 | 3,147,000 | | | | | | | | | 629,400 | 3,147,000 |
| 1884 | 37 | 620,000 | 2,915,000 | | | | | | | | | 620,000 | 2,915,000 |
| 1885 | 37 | 553,800 | 2,500,000 | | | | | | | | | 553,800 | 2,500,000 |
| 1886 | 39 | 448,500 | 2,135,000 | | | | | | | | | 448,500 | 2,135,000 |
| 1887 | 39 | 356,000 | 2,124,000 | | | | | | | | | 356,000 | 2,124,000 |
| 1888 | 28 | 372,477 | 2,234,862 | | | | | | | | | 372,477 | 2,234,862 |
| 1889 | 21 | 266,697 | 1,600,182 | 17,797 | $101,051 | | | | | 25,391 | $108,587 | 309,885 | 1,809,820 |
| 1890 | 21 | 335,604 | 1,946,087 | 57,345 | 290,069 | | | | | 42,825 | 171,300 | 435,774 | 2,407,456 |
| 1891 | 22 | 353,907 | 2,038,566 | 15,482 | 284,242 | | | | | 29,564 | 118,156 | 398,953 | 2,440,964 |
| 1892 | 24 | 344,267 | 1,906,388 | 66,547 | 372,909 | 4,176 | $20,880 | | | 72,348 | 288,892 | 487,338 | 2,679,069 |
| 1893 | 24 | 288,773 | 1,559,374 | 30,459 | 152,295 | 29,107 | 116,428 | 2,311 | $6,933 | 65,226 | 260,904 | 415,876 | 2,095,934 |
| 1894 | 24 | 351,106 | 1,895,976 | 43,814 | 224,430 | 42,758 | 171,032 | | | 52,422 | 209,688 | 490,100 | 2,501,126 |
| 1895 | 24 | 444,900 | 2,428,658 | 18,015 | 86,523 | 99,001 | 329,683 | 22,493 | 62,591 | 49,678 | 203,542 | 634,696 | 3,110,997 |
| 1896 | 24 | 370,943 | 1,840,511 | 16,983 | 81,518 | 44,108 | 141,145 | | | 49,653 | 198,652 | 481,697 | 2,261,826 |
| 1897 | 22 | 432,753 | 1,804,221 | 12,972 | 51,888 | 60,850 | 197,762 | | | 46,146 | 165,440 | 552,721 | 2,219,311 |
| 1898 | 23 | 329,566 | 1,490,394 | 66,670 | 300,015 | 65,431 | 222,465 | | | 26,277 | 60,352 | 487,944 | 2,073,226 |
| 1899 | 17 | 255,824 | 1,458,175 | 23,969 | 134,723 | 29,608 | 112,055 | 11,379 | 33,836 | 11,994 | 39,186 | 332,774 | 1,777,975 |
| 1900 | 16 | 262,392 | 1,821,258 | 13,162 | 92,184 | 44,925 | 202,163 | 17,696 | 63,706 | 20,597 | 102,985 | 358,772 | 2,282,296 |
| 1901 | 13 | | | | | | | | | | | [4] 390,183 | 1,942,660 |
| 1902 | 14 | 270,580 | 1,428,743 | 17,037 | 86,465 | 10,532 | 44,732 | 10,401 | 41,604 | 8,593 | 42,965 | 317,143 | 1,644,509 |
| 1903 | 16 | 301,762 | 1,610,614 | 8,383 | 42,867 | 12,181 | 49,869 | 10,000 | 37,500 | 7,251 | 36,255 | 339,577 | 1,777,105 |
| 1904 | 20 | 320,378 | 1,944,690 | 12,911 | 78,048 | 31,254 | 118,357 | 20,693 | 52,691 | 9,868 | 48,892 | 395,104 | 2,242,678 |
| 1905 | 19 | 327,106 | 1,962,636 | 7,768 | 46,608 | 26,820 | 114,011 | 25,751 | 65,206 | 9,822 | 49,110 | 397,273 | 2,237,571 |
| 1906 | 19 | 311,334 | 1,868,007 | 7,816 | 54,712 | 41,446 | 124,338 | 27,802 | 69,505 | 6,500 | 32,500 | 394,898 | 2,149,062 |

[1] Pack by species and value by species, except blueback pack and value for 1909, and the number of canneries for the years 1878, 1879, 1888–1900, 1902–20, and 1922 to 1936, inclusive, from the Pacific Fisherman Yearbooks. The number of canneries for the remaining years from information obtained from the various early Astoria, Oreg., newspapers, except for the year 1921 which was taken from the 1922 Pacific Fisherman Yearbook.

[2] A man by the name of Aldrich had a small cannery on a scow this year. This pack is not known.

[3] Jones (1888) and Collins (1892) give 460,000 cases for this year's pack.

[4] No pack by species available.

TABLE 1.—*Pack of canned salmon on the Columbia River, 1866 to 1936, inclusive*—Continued

| Year | Number of canneries operated | Chinook | | Blueback | | Silver | | Chum | | Steelhead | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cases | Value | Cases | Value | Cases | Value | Cases | Value | Cases | Value | Cases | Value |
| 1907 | 19 | 258,433 | ---------- | 5,504 | ---------- | 31,757 | ---------- | 22,556 | ---------- | 5,921 | ---------- | 324,171 | 1,763,490 |
| 1908 | 14 | 210,096 | ---------- | 8,581 | ---------- | 31,432 | ---------- | 16,884 | ---------- | 10,726 | ---------- | 277,719 | 1,380,708 |
| 1909 | 15 | 162,131 | 1,203,546 | [5]25,062 | 192,677 | 42,178 | 185,070 | 24,542 | 57,115 | 17,283 | 99,796 | 271,196 | 1,738,204 |
| 1910 | 15 | 244,285 | 1,882,137 | 6,234 | 34,287 | 68,922 | 363,688 | 66,538 | 232,883 | 5,436 | 31,203 | 391,415 | 2,544,198 |
| 1911 | 15 | 405,862 | 2,204,185 | 5,968 | 47,904 | 79,416 | 549,478 | 53,471 | 203,198 | 8,594 | 47,399 | 553,331 | 3,052,164 |
| 1912 | 15 | 220,317 | 1,968,526 | 8,210 | 85,384 | 31,842 | 177,248 | 18,699 | 46,590 | 6,958 | 22,108 | 286,026 | 2,319,856 |
| 1913 | 15 | 192,116 | 1,664,670 | 11,152 | 93,677 | 40,969 | 175,412 | 13,303 | 29,486 | 8,930 | 49,142 | 266,479 | 2,012,387 |
| 1914 | 17 | 289,464 | 2,573,502 | 35,311 | 376,924 | 69,769 | 380,666 | 49,285 | 205,541 | 10,792 | 59,356 | 454,621 | 3,595,989 |
| 1915 | 19 | 406,486 | 3,694,361 | 5,459 | 56,707 | 83,336 | 173,234 | 86,530 | 251,632 | 26,723 | 129,358 | 558,534 | 4,305,292 |
| 1916 | 20 | 395,166 | 3,572,203 | 3,790 | 27,288 | 52,064 | 335,114 | 77,766 | 307,483 | 18,999 | 118,987 | 547,805 | 4,361,075 |
| 1917 | 20 | 403,637 | 5,023,529 | 7,968 | 111,552 | 64,299 | 700,680 | 53,659 | 386,596 | 23,783 | 292,538 | 553,346 | 6,514,895 |
| 1918 | 20 | 400,952 | 5,222,983 | 37,833 | 605,328 | 98,145 | 1,072,843 | 29,846 | 215,669 | 24,605 | 350,071 | 591,381 | 7,466,894 |
| 1919 | 21 | 392,125 | 5,455,550 | 7,268 | 145,300 | 90,728 | 1,142,767 | 75,493 | 541,969 | 14,414 | 205,254 | 580,028 | 7,490,920 |
| 1920 | 22 | 420,467 | 5,661,580 | 2,617 | 62,808 | 27,024 | 257,806 | 18,792 | 99,564 | 12,645 | 116,859 | 481,545 | 6,198,617 |
| 1921 | 20 | 267,582 | 3,761,321 | 6,045 | 120,900 | 34,381 | 233,372 | 4,821 | 19,791 | 10,142 | 68,266 | 322,971 | 4,203,650 |
| 1922 | 23 | 237,230 | 3,724,393 | 30,743 | 614,860 | 90,437 | 633,935 | 8,844 | 47,130 | 24,920 | 186,675 | 392,174 | 5,206,993 |
| 1923 | 23 | 289,586 | 4,967,657 | 38,309 | 766,180 | 101,554 | 673,954 | 25,508 | 135,168 | 25,968 | 187,965 | 480,925 | 6,730,924 |
| 1924 | 22 | 293,716 | 4,508,236 | 7,366 | 129,840 | 112,308 | 992,865 | 57,748 | 303,356 | 29,734 | 285,107 | 500,872 | 6,219,404 |
| 1925 | 21 | 350,809 | 5,423,129 | 5,650 | 106,220 | [6]113,544 | 1,488,855 | 55,812 | 272,398 | 14,637 | 177,866 | 540,452 | 7,468,468 |
| 1926 | 21 | 295,302 | 4,744,131 | 21,736 | 434,720 | 97,142 | 1,027,597 | 32,853 | 181,216 | 32,690 | 356,418 | 479,723 | 6,744,082 |
| 1927 | 22 | 339,446 | 5,559,202 | 6,887 | 147,378 | 74,879 | 585,816 | 68,449 | 428,240 | 30,148 | 311,070 | 519,809 | 7,028,706 |
| 1928 | 24 | 251,404 | 4,355,218 | 4,814 | 100,131 | 49,136 | 478,355 | 124,953 | 747,619 | 16,339 | 222,139 | 446,646 | 5,903,462 |
| 1929 | 21 | 242,938 | 4,234,214 | 10,072 | 181,296 | 90,684 | 917,561 | 54,619 | 314,928 | 23,804 | 257,025 | 422,117 | 5,905,024 |
| 1930 | 21 | 281,346 | 4,092,810 | 9,823 | 194,460 | 110,430 | 1,156,042 | 11,371 | 43,324 | 16,535 | 171,541 | 429,505 | 5,658,177 |
| 1931 | 20 | 294,798 | 3,754,929 | 4,125 | 66,000 | 39,268 | 247,878 | 3,518 | 11,764 | 11,990 | 110,429 | 353,699 | 4,191,000 |
| 1932 | 15 | 216,511 | 2,023,390 | 2,795 | 43,540 | 46,492 | 280,853 | 17,261 | 44,879 | 13,132 | 91,924 | 296,191 | 2,444,586 |
| 1933 | 14 | 251,157 | 2,719,303 | 6,921 | 96,894 | 36,430 | 263,190 | 24,398 | 107,351 | 17,805 | 142,440 | 336,711 | 3,329,178 |
| 1934 | 13 | 251,068 | 2,630,152 | 6,869 | 82,428 | 65,428 | 536,731 | 24,455 | 92,608 | 14,901 | 121,000 | 362,721 | 3,462,919 |
| 1935 | 10 | 205,870 | 2,479,450 | 1,302 | 17,619 | 95,184 | 725,868 | 15,495 | 59,499 | 14,888 | 122,846 | 332,739 | 3,405,282 |
| 1936 | 11 | 220,188 | 2,964,058 | 9,837 | 137,718 | 36,541 | 303,263 | 30,597 | 110,149 | 19,282 | 317,867 | 316,445 | 3,833,055 |

[5] In addition, 2,846 cases, valued at $23,203, were packed with sockeyes brought from Puget Sound (Pacific Fisherman Yearbook, 1922).

[6] This is the pack given by the 1926 Pacific Fisherman Yearbook, whereas the historical table in that same volume and in all following ones gives 113,554 cases.

## METHODS AND MACHINERY

Many of the improvements in the mechanics and technique of salmon canning were of fundamental importance in the expansion and development of the industry and should, therefore, be mentioned in this record. The first crude methods are described in the following quotation (Hume, 1904):

> Before the arrival of Mr. Hapgood (from Maine) the Hume brothers had purchased a large scow, on which they proposed to do the canning of salmon, and had added an extension to the cabin 18 x 24 feet in area, to be used as a can-making shop. This had a shed on the side next to the river for holding any cans that might be made in advance of the packing season. A few days after the arrival of Mr. Hapgood (March 23, 1864), the tools and machinery were packed and put in position. Mr. Hapgood made some stovepipe and two or three sheet-iron fire pots, and in a short time was ready for can making. The following list of tools and machinery will show how primitive our facilities were as compared with present methods: 1 screw hand press, 1 set cast-iron top dies, 1 set cast-iron bottom dies, 1 pair squaring shears, 1 pair rotary shears, 1 pair bench shears, 1 pair hand shears or snips, 1 pair 24-inch rolls, 1 anvil (weight 50 pounds), 1 forging hammer, 1 tinner's hammer, 1 set punches for making stovepipe, 1 rivet set, 1 grooving set, 2 iron slabs grooved on one side to mold strips of solder, 1 iron clamp to hold bodies of cans while soldering the seams, 1 triangular piece of cast iron about three-eighths of an inch in thickness and 6 inches in length, with a wooden handle attached to the apex, also used for holding can bodies in place while being seamed.
>
> The process of canning was as follows: The bodies of the cans were first cut to proper size by the squaring shears, a line was then scribed with a gauge about three-sixteenths of an inch from one edge, and they were next formed into cylindrical shape by the rolls. They were then taken to the soldering bench and one edge lapped by the other until the edge met the line that had been scribed and fastened there by being soldered a small part of the length to hold them in place for the further

purpose of seaming. They were then placed either in the iron clamp, which had a piece of wood attached to its underside, and held firmly, the clamp being closed by the operation of a treadle, or were slipped on a piece of wood, which was bolted to the bench, while being held in place by the triangular hand seamer, which was pressed down on the lap of the seam by the left hand of the operator. When this had been done a piece of solder, which had been prepared by shaking in a can together with rosin, was placed on the seam and melted and rubbed lengthwise of the seam. After cooling the bodies were ready for the end or bottom, which operation was brought about by first cutting out circular blanks with the rotary shears, and then placing them in the cast-iron die and bringing the handle of the screw press around with a swing with force enough to form up the end or bottom. In this operation there were many difficulties, as the ends or bottoms would many times stick to the upper part of the die and refuse to come off, and finger nails were pretty short in those days. To get the ends out of the lower part of the die was not so bad, as a wooden plunger operated by a treadle knocked them out, but sometimes they were in pretty bad shape. When the bottoms or ends were ready they were slipped on the bodies and the edge of the bottom rolled about in a pan of powdered rosin until the seam was well dusted. A piece of solder similar in size and preparation as used for the side seam was placed in the can. They were then placed on the smooth side of the cast-iron slabs, and the operator, with a hot soldering copper shaped to fit the circle of the can, melted the solder and by turning the can rapidly soldered the full circumference. The output of this can factory was very imperfect, and at least one-half of the seams burst, owing to the lack of experience of the manager or want of good judgment.

When the can making was well underway Mr. Hapgood then turned his attention to getting the apparatus for canning on board the house-boat. This in the cooking department consisted of a kettle made of boiler iron about 36 inches in diameter and 5 feet in depth, set in a brick furnace and fired from underneath. Alongside was a round-bottom, cast-iron pot holding about 60 gallons of water and heated in the same manner. These kettles, with a dozen coolers or circular sheet-iron pans with ropes attached and with holes cut in the bottoms for drainage, a set of 5-inch blocks and tackle, with a sheet-iron fire pot and a scratch awl, completed the bathroom outfit. The can filling and soldering room was furnished with a table through the center, where cutting the salmon in pieces to suit and the filling of the cans was done. On each side of the room there was a bench running the full length, on the end of one of which the cans were placed to receive the pickle, which was used at that time instead of the small quantity of salt that is placed in the cans during the operations of these later days. After the salmon had been cleaned by removing the entrails and washing them outside the covered portion of the scow, they were brought inside and placed on the table, and a man with a butcher knife in one hand and a stick in the other, which had a mark showing the length of the pieces desired, cut gashes in the side of the salmon as a guide and then cut the fish into sections corresponding to the length of the mark on the stick. He then proceeded to cut the sections in pieces to suit the cans. Then three or four operators placed the salmons in the cans and shoved them along the table to where a boy wiped the top edge and passed them along to two others who placed tops which fitted inside of the rim. The cans were then taken in wooden trays to the bench opposite the starting point, which was fitted with four sheet-iron pots, and at the one nearest the entrance to the house on the scow a man put a soldering flux on the top edge, which was made by adding zinc to muriatic acid, and then with a pointed soldering cooper and a stick of solder melted the solder until a small portion could be drawn around the groove formed by the edge of the can and the bevel of the top. From there the cans were taken to the other parts of the bench, where two men finished soldering the head in, and then taken to the third man, who soldered, or, as it was called, buttoned, the end of the seam lap. The cooking department or bathroom, as it was called, was separated from the filling and soldering room by a partition. The cans were shoved through a hole in the partition.

At this time the process was a secret. Mr. Hapgood did the cooking and all the work done inside, no one but a member of the firm being allowed to go in. This privacy was continued until the firm moved to the Columbia River, and, the labor becoming too arduous for Mr. Hapgood to perform alone, a boy by the name of Charlie Taylor was taken in as an assistant. * * *

But to return to the original proposition: When the filled cans had been soldered and entered the bathroom they were put in the coolers and lowered into the cast-iron pot, one cooler of cans being cooked at a time. The cooler was lowered into the boiling fresh water until the cans were submerged to within 1 inch of the top ends and left to cook for one hour; then they were hoisted out and the vent holes in the center of the top soldered up, after which they were dumped into the boiler-iron kettle, which held a solution of salt and water of density sufficient to produce, when boiling, a heat of 228° to 230° F. They were cooked in this solution for one hour and then taken out of the kettle with an iron scoop shaped like a dip net, with a wooden handle about 6 feet in length. They were dumped into a tank of water on the other side of the partition which separated the bathroom from the packing room through an opening in the partition, receiving many a bump and bruise in the operation. Then they were washed with soap and rag to remove the dirt and grease, each can being handled separately. When this was done they were piled on the floor of the packing room and in a few days were painted with a mixture of red lead, turpentine, and linseed oil, for at that time buyers would have no canned salmon, no matter how good the quality, unless the cans were painted red.

*Can making.*—The making of cans was a considerable portion of the labor involved in these early canning operations and it was not long before important improvements were made in this part of the process. In 1877 R. D. Hume obtained Howe machines for soldering ends, from eastern manufacturers, and installed them in his Rogue River cannery. These machines were soon in use in other canneries. The first important improvement upon these machines was the Haller seamer which was put into use in 1882. This machine enabled one skilled and two unskilled workmen to do the work of five skilled men, reduced the number of fires necessary from five to one, and produced more uniform and stronger cans.

Prior to 1883, the bodies of all salmon cans were lap-seamed and made on iron cylinders, the seams being soldered by hand with a soldering copper, but in 1883 the Pacific Can Co. of San Francisco commenced the manufacture of lock-seam cans. The bodies for these cans were formed and soldered on an automatic body machine and side-seam solderer, the seam being locked together instead of lapped, insuring a much better and stronger seam than the old method. The ends were put onto the bodies by an automatic ending machine and the cans then carried automatically to the end-seam solderer, where the work was completed. All of the cans manufactured this first year were purchased by the Alaska Packing Co.

The Pacific Can Co. established a factory in Astoria in 1893, and in 8 months of the following year turned out 15,000,000 cans. A few years later the company was absorbed by the American Can Co., and the Astoria plant was moved to Portland.

The first experiments with sanitary, double-seamed, solderless salmon cans were tried on the Columbia shortly after 1900, but were abandoned because of the inability to get machines which were sufficiently fast to "make a pack," and the further difficulty of making a double-seamed can with a lap-seamed body which would stand the pressure of double seaming the ends without splitting the side seams. The American Can Co. finally developed a can-body former which would make a combination lock and lap seam. This machine made 6,500 can bodies per hour. In the meantime Axel Johnson, of San Francisco, invented the Johnson double-seamer. The double-seamed can had long been used in Europe and for a number of years in the East. Its general use had waited on automatic machinery which would manufacture it economically. The Columbia River Packers Association and J. G. Megler put up some fish in the American Can Co.'s new sanitary can in 1909 and others soon began to adopt it.

The Johnson double-seamer was installed in the Sanborn-Cutting Packing Co.'s cannery by the American Can Co. in 1910. It put the tops on permanently and but one cooking was required. This new machinery, together with the development of the steam-exhaust box, eliminated the venting of the cans, and in this way much of the former loss of oil was saved and the natural flavor of the fish preserved. The cannery was able to pack 2,000 cases in 10 hours with less expense than they formerly could pack 800 cases. Also, the use of tissue paper wrapping around the cans was done away with, except in the case of a few special packs. The Sanborn-Cutting Co. was the first salmon cannery to completely adopt the sanitary process.

Although can manufacturing had been begun by the California Can Co. of San Francisco about 1881, and was carried on later by the Pacific Sheet Metal Works (Pacific Can Co.), in San Francisco and Astoria, and then the American Can Co. of Portland, a few operators continued to make their own cans.

*Butchering and can filling.*—Strangely enough the first machine for automatically filling cans appears to have been used on the Columbia River, although even at the present time very few of these machines are used in that area. This first machine was made by R. D. Hume and John West early in 1880 and, according to old reports, it operated very satisfactorily. In 1882 John West made another machine and by August of that year about 20 of these machines were in use.

Mathias Jensen made a mechanical filler in 1883. This may well be considered the first automatic can filler of the modern type. These fillers had a capacity of approximately 48 cans per minute and were manufactured by John Fox in his shop in Astoria, Oreg., in partnership with Sylvester Farrell and Mathias Jensen.

In 1902 another can-filling machine was put out by Letson & Burpee, of Bellingham (formerly Fairhaven), Wash., under the name of the Fulton filling machine. The efficiency and speed of these machines have been increased since that time.

A large part of the salmon pack of the Columbia is chinook salmon prepared for sale to a high-class trade. In putting up a pack of this character the packers deem it advisable to have it hand packed and therefore the filling machines have been used very little. The few that are in use on the Columbia are operated in packing some of the lower-quality fish.

A machine which automatically dresses the fish was first used at Bellingham, Wash., in 1903. This machine, called the "iron chink," opens and eviscerates the fish, removes head, tail, and fins, and cleans it so that it is ready to be cut into sections and placed in the cans. Despite their high efficiency these machines are not used in the Columbia River canneries because of the wide variation in size of the fish available to those plants. The chinook salmon packed in any one day may range from 5 to 60 pounds in weight, and the resetting of the machines or sorting of the fish by size, which would be necessary, is thought to be too great a task for the labor saved by the iron chink. Therefore the Columbia River canneries continue to hand butcher their salmon. However, power- or hand-operated gang knives are used to cut the fish into sections of suitable length to fit the cans.

*Evacuating of cans, and cooking.*—Along with improvements in the construction and technique of manufacturing cans there was considerable advancement made in the process of evacuating the air from the cans before they are sealed and cooked. The original method of accomplishing this was to first make a small hole in the top of the can after it had been soldered in. The cans were then cooked in boiling water which was allowed to rise to within about one-half inch of the top of the cans, heating the contents of the cans so that the air was forced out through the opening in the top. The hole was then closed with a drop of solder. A small piece of tin which had been placed under the hole before the top was soldered in prevented the molten solder from dropping into direct contact with the contents of the can.

The next step in the progress of this phase of the salmon-canning operations was the steam-exhaust box. This equipment came into use in conjunction with the double-seamer in about 1910. One variety of this equipment consisted of a compartment fitted with steam coils between which the cans passed on an endless belt, the lower coils having straight pipes below them which discharged live steam through holes upon these coils and created an intense heat. Another type heated and exhausted the cans by discharging steam directly from the coils. The cans had the lids placed on loosely in such a way that the condensed steam could not enter but that the air could escape. After this process the tops of the cans were crimped on without solder in the double-seamer. The present method of using machinery for exhausting the air from the cans by means of vacuum pumps was next employed and this operation is now carried out at the same time that the lid is fastened on with the double-seamer, now called vacuum-seamer, thus saving the time and space previously required for the steam-exhaust box.

After the evacuation and sealing of the cans the next step in the process is the cooking. The first method of accomplishing this was to submerge the cans in a solution of salt and water and boil them for about 1 hour at a temperature of approximately 230° F. This process was improved upon in 1874 when Warren & Co.'s Cathlamet Cannery began cooking salmon by what was then called the dry-steam process. This was the first attempt at cooking in retorts, as we now know them. Warren then patented a retort in 1877 which was made of wood and held up to 20 pounds' pressure. Other cannerymen quickly took up the use of these retorts and John Fox began making them of iron at his Astoria Iron Works in 1882, but in 1896 some wooden retorts were still in use.

In the early years of its use the operators thought that retort cooking caused the canned product to be excessively dry. Therefore, they boiled the filled cans from 45 to 60 minutes, vented and resoldered the cans, and then cooked them at 240° F. under 10 pounds' pressure for 60 minutes in the retorts. At a later date they cooked them for an hour at 230° F. in the retort, then vented and resoldered them and cooked them again in the retort about 1 hour at 240° F.

F. A. Seufert, in 1896, was the first cannery operator to cook his salmon only once. Other cannerymen followed his example and this is now the universal practice.

*Protection of cans.*—In the very early days of the industry the cans were covered with red paint. This was done because the English and foreign market had become accustomed to such cans and demanded them, and also to protect the cans from rusting which caused a considerable loss of the crudely made cans of that period. The cans were then covered with tissue paper and the labels were placed on top of this covering. The first step in advancement was to lacquer the cans instead of painting them. This was a faster process and did away with the necessity for the tissue coverings, as the labels could be attached directly to the cans. However, this was also a rather laborious procedure and at present the cans are purchased with the ends enamelled and the sides untreated and are sold in that condition, thus eliminating the lacquering altogether. The labels usually cover the entire side of the cans and assist in protecting them.

Many minor improvements such as rapid methods of salting the cans, labeling machines, and automatic conveyors for fish, cans, and boxes in the canneries have been developed as the industry has progressed. When all of these improvements are considered it is evident that the efficiency and capacity of the modern canneries is much greater than of those in the early days of the industry when the packing plants were most numerous.

## MARKETS FOR CANNED SALMON

All industries must have a market for their products and be able to dispose of them at a profitable figure if they are to be successful. In preceding pages we have noted that the Indians living on the Columbia carried on a commerce of dried salmon and pemmican with tribes less fortunately situated in regard to fishing, and that the Hudson's Bay Co. and other early traders and saltery operators exported salted salmon to the Hawaiian Islands, the east coast of the United States, and other localities, as well as using some of the fish locally. However, the advent of the canning industry with its immense potential production put an entirely new aspect upon the situation. A large and stable market had to be developed if the new venture were to prosper. The amazing rapidity with which this was accomplished is attested by the great increase in production and the expansion which the industry displayed in its first few years. However, this introduction of canned salmon into the world's channels of trade was not accomplished by the Columbia River operators alone. The salmon fisheries of the Fraser River were developing at the same time and, beginning in 1878, canned salmon from Alaska became an increasingly important factor.

It is evident that during the first years of the canning industry the principal market was outside of the borders of the United States. South America, China, and the Hawaiian Islands are mentioned as points of destination for canned salmon shipped from Astoria, Oreg., in 1871, and California also received part of the pack of that year. The manner in which the market was being extended and enlarged in the seventies is shown by the following quotation from the Tri-Weekly Astorian of November 29, 1873:

> When canning was commenced on the Columbia River five years since, it was difficult to effect the sales of fish so preserved. Purchasers had to be solicited, and consumers made acquainted with the novelty. This year, however, orders were received from Europe before the first fish could be taken, one firm having an order ahead for 15,000 cases. All the fisheries have been able to realize as fast as the salmon could be placed on board ship and no longer will canners have to beg of the people to taste an unknown dish.

By 1874 canned salmon was being shipped to New York, St. Louis, Chicago, Memphis, and New Orleans. Some idea of the foreign distribution of the Columbia River pack during these early years may be obtained by referring to table 2. However, as late as 1886 the market for Columbia River salmon in the United States was still quite limited. Evidently the amount used by the domestic market increased steadily, because we find quoted a statement from the Herald of Trade (probably Herald of Trade and Finance, San Francisco), April 1, 1892, that 80 percent of the current season's salmon pack was sold in the domestic market. This same journal in the issue of October 14, 1892, states that prior to 1888 Great Britain had controlled the salmon market, but since that year the trade in the United States had increased to a point where it was the controlling factor by virtue of consuming at least two-thirds of the pack.

The construction of the transcontinental railroads were of great importance in facilitating the opening of eastern American and European markets to the Pacific coast salmon packers. In order to reach either of these areas, the canned salmon was shipped by sailing vessels around Cape Horn until 1869 when the Central Pacific was completed from San Francisco, Calif., to Omaha, Nebr. Salmon could then be shipped by boat from Astoria to San Francisco and then by train to the east coast. Conditions were still further improved when the Northern Pacific reached Portland, Oreg., in 1883. Direct rail connection was finally made with Astoria in 1898 by the Astoria and Columbia River Railway which ran from Astoria to Goble, where it connected with the Northern Pacific.

TABLE 2.—*Salmon exports by sea from Oregon for 1874* [1]

| Destination | Packages | Value | Destination | Packages | Value |
|---|---|---|---|---|---|
| Australia | 25,820 | $194,197 | New Zealand | 4,960 | $35,991 |
| Honolulu | 234 | 1,099 | New York | 15,814 | 100,571 |
| Tahiti | 1,903 | 13,392 | Cape Town | 350 | 2,750 |
| Callao, etc. | 2,832 | 21,023 | Manila | 309 | 1,920 |
| Central America | 849 | 2,323 | Other countries | 5,711 | 18,776 |
| Panama | 719 | 4,456 | | | |
| England, etc. | 109,849 | 776,776 | Total | 169,350 | 1,173,274 |

[1] Data from the Weekly Astorian, Feb. 4, 1875.

## SALTED AND MILD-CURED SALMON

Much of the early development of the salmon-salting operations has been discussed in the section dealing with the intermediate period of the salmon fishery, however, a brief review of some of those facts is presented in this section.

Curing salmon by salting them in barrels and leaving them covered with brine or pickle was the original method adopted by the white men along the Columbia River for the preservation of fish which were to be either kept for home consumption or shipped to a distant market. The procedure followed was exceedingly simple. The fish were split, eviscerated, and washed or soaked sufficiently to make them clean and perfectly free from blood. They were then placed flesh side up in containers and salted. In a few days there were thoroughly "struck" or permeated with salt and ready to be packed, repickled, and otherwise prepared for shipment.

The salmon of the Columbia were introduced into the markets of Honolulu, Valparaiso, and London by the Hudson's Bay Co. Salmon sent to London between 1830 and 1835 did not at first prove profitable. As previously mentioned on page 148, a part of the cargo of the brig *May Dacre* in 1835, brought $12 per barrel at the Hawaiian Islands and $17 at Boston. Many of the American vessels that entered the river in the 1830's and 1840's took some salted salmon away with them. At about this time Wyeth, a trader, Waller, and some of the other missionaries attempted to compete with the Hudson's Bay Co., but they were able to obtain only enough salmon for home consumption, the company being willing to pay the Indians more for their fish.

Wilkes estimated that the Hudson's Bay Co. purchased 800 barrels of salmon from the Indians at Willamette Falls in 1841 and in that same year Captain Spaulding expressed the opinion that the company took 1,000 barrels annually, 300 of which were given to the Indians every winter to keep them alive. At this time the company was receiving from $10 to $12 per barrel of 180 pounds when delivered at the Hawaiian Islands. The company either sold or expected to sell salmon in the markets of both the United States and China.

Suckley and Cooper (1860) have given the following account of the early salmon salting carried on by the Americans after the Hudson's Bay Co. had left the river.

> In 1853 and 1854 large quantities of salmon were salted for market at the fisheries near the mouth of the Columbia, and at the Cascades, about 150 miles above. Although the fish, being those taken in spring and summer, were of the finest quality, second to none in the world * * *

> owing to the carelessness in packing, and to the expense and difficulty that then attended the procurement of proper barrels and good salt, nearly all who went into the business lost money; and the salmon thus miserably preserved reached the markets of San Francisco and New York in such bad condition that they obtained a bad reputation among dealers.
>
> In curing, the salmon shrinks one-half in bulk. This shrinking should take place in the "striking tubs" before packing, that they may keep solid. (After going thru the "striking tubs" I am told that the salmon should be forced into the barrels by a press or screw, so that the fish which are piled up to a point one-third higher than the depth of the barrel shall be forced in by the barrel head, which is pushed down by the screw. Thus closely packed, there is no danger of their working and becoming disorganized by the motion of a vessel at sea.)

Between 1850 and 1865 several men, including Hodgkins, Sanders, P. J. McGowan, Ball, H. N. Rice, and Jotham Reed, packed salted salmon and their activities have been described in the section dealing with the intermediate period of the salmon fisheries.

The Tri-Weekly Astorian, November 29, 1873, comments upon this early industry immediately following this period.

> The market for pickled salmon was confined chiefly to the Hawaiian Islands and for home demands before the completion of the first transcontinental railway to San Francisco in 1869. The fish would not bear shipment through the tropics on long voyages, but with the completion of the railway the market was extended, not only for pickled but also for fresh salmon.

It is evident that some companies continued to pack salmon in barrels during the early years of the canning industry, since, in 1872, 13,000 barrels were packed and, in 1874, 20,000 barrels. The large pack of salt salmon was made in this latter year because the canners had not anticipated such a heavy run of fish and did not have a sufficient number of cans on hand (Weekly Astorian, August 27, 1874). The following sizes of containers for salted salmon were in use during the early seventies: Barrel, 200 pounds; half barrel, 100 pounds; kits, 25 to 50 pounds; and tierces, 300 to 400 pounds. In 1875, Sam Oliver put up 1,200 barrels and Booth & Co., 1,500 barrels, including half barrels. Fitzpatrick, Falkinburg, Warren & Co., Cook Bros., Hepburn, and others put up large quantities. Probably 4,000 to 5,000 barrels were put up by the 4 leading packing companies (Weekly Astorian, August 21, 1875). In addition to these companies there was one at The Dalles curing salmon and putting them up in half barrels of 12 fish each (Daily Astorian, June 16, 1877). Of the 1879 pack of salted salmon, 1,977 barrels, and 600 kits and half barrels were shipped to San Francisco and foreign markets (Daily Astorian, January 20, 1880). A large pack was put up in the following year (Weekly Astorian, August 13, 1880).

The first attempt to improve salted fish, and the beginning of the transition from heavily salted to mild-cured fish came in 1889 when a young man by the name of J. Lindenberger, from Germany, arrived on the Columbia River and tried to interest some of the cannerymen in the sweet pickling of salmon for the German market. Hantborn, Kinney & Cook put up fish by his method. The plant of the Northwest Cold Storage Co., at Portland, Oreg., was used to keep the fish at a low temperature during repacking and preparation for shipment. The shipment was sent, but the fish were not satisfactory. This enterprise was not tried again until 1894 when Mueller & Loring, of Chicago, put up a carload at Kalama, Wash. It is not known what happened to this shipment to Germany. In 1896 Charles Ruckles, of Kalama, packed 1 carload for J. Ryback, of Germany, and Wallace Bros., of the same place, also packed 1 carload for Germany (Cobb, 1930; Pacific Fisherman, 1903 Annual, p. 64).

Mild-curing of salmon had its permanent beginning in 1897 when S. Schmidt & Co. moved from Portland, Oreg., to Astoria, Oreg., because of the increased demand for mild-cured salmon for which they had been developing a process, and when the Trescott Packing Co. established a mild-cure plant at Warrenton, Oreg. Each company put up 160 tons of mild-cured salmon (Pacific Fisherman, 1903 Annual, p. 64, and ibid. vol. II, no. 9, pp. 24–26). The new process used by S. Schmidt & Co. may have been one using one-third sugar and two-thirds salt. By 1906 almost all of the packers were again using only salt applied in what is now known as the mild-cure method.

This method is as follows: Great care is exercised in selecting the salmon which are to be mild-cured, since they must be large, fat salmon, fresh, and not bruised. The fish are eviscerated and the heads removed, part of the bony shoulder girdle being left for convenience in handling the fish during curing and thereafter. The body cavities of the fish are carefully cleaned of all blood and the outside is lightly scored with a sharp knife to permit the salt pickle to penetrate during curing. After this operation the fish go to the splitter, who, using a sharp knife, removes the backbone and fins and splits the fish into halves. These sides are then taken to the salter who places them on the salting table and rubs the flesh gently with salt. The sides are then placed in tierces, skin side down on two or three handfuls of salt. A like quantity of salt is then added on top of them and another layer of sides added until the tierce is filled. From 85 to 100 pounds of salt are used to 800 pounds of fish. The tierce is then headed up and brine of a strength of at least 90° (90 percent saturated solution) is added. The fish are kept in cold storage at a temperature of 35°–38° F. for from 20 to 90 days. The tierces must be watched carefully and kept full of pickling fluid during that time. After this period of storage the salmon sides are lifted out of the tierces and carefully cleaned and dried. They are then replaced in the tierces without salt, and brine of about 90° strength is added. The fish is then ready for shipment, but must be kept in cold storage and the tierces watched carefully for leaks or evaporation. The fish, being only slack-salted, are sent in refrigerator cars to New York and in the cold-storage rooms of steamers to Europe, when intended for that destination.

The European demand for pickled or mild-cured salmon began in about 1896, and until the World War most of this product was shipped across the Atlantic. Chinook salmon only were used in supplying this foreign trade in pickled salmon, and large-size fat fish were desired, because most of these fish were smoked in Europe before being offered to the consumer. Shipment of salmon from the lower river was facilitated by the completion of the railroad from Portland to Astoria in the spring of 1898 and the number of companies putting up mild-cured salmon increased rapidly. Eleven companies prepared fish in this manner in 1904. The maximum pack of 9,805 tierces which was put up the next year was a considerable portion of that year's total salmon catch. After this the number of tierces annually packed decreased slowly until 1916. The following year the United States entered the World War, the European market was gone, and the pack fell to 1,886 tierces, 2,770 tierces below the 1916 pack. The pack has never regained its pre-war level, but has fluctuated between slightly less than 1,000 and a little more than 3,000 tierces.

**TABLE 3.**—*Columbia River mild-cured salmon pack and its equivalent in pounds of round fish, 1897 to 1936* [1]

| Year | Chinooks | | Silvers | | Total | |
|---|---|---|---|---|---|---|
| | Tierces [2] | Pounds | Tierces [2] | Pounds | Tierces | Pounds |
| 1897 | 400 | 440,000 | ---- | ---- | 400 | 440,000 |
| 1898 | 700 | 770,000 | ---- | ---- | 700 | 770,000 |
| 1899 | 1,250 | 1,375,000 | ---- | ---- | 1,250 | 1,375,000 |
| 1900 | 1,275 | 1,402,500 | ---- | ---- | 1,275 | 1,402,500 |
| 1901 | 3,000 | 3,300,000 | ---- | ---- | 3,000 | 3,300,000 |
| 1902 | 4,213 | 4,634,300 | ---- | ---- | 4,213 | 4,634,300 |
| 1903 | 6,725 | 7,397,500 | ---- | ---- | 6,725 | 7,397,500 |
| 1904 | 9,088 | 9,996,800 | ---- | ---- | 9,088 | 9,996,800 |
| 1905 | 9,805 | 10,785,500 | ---- | ---- | 9,805 | 10,785,500 |
| 1906 | 8,000 | 8,800,000 | ---- | ---- | 8,000 | 8,800,000 |
| 1907 | 6,070 | 6,677,000 | ---- | ---- | 6,070 | 6,677,000 |
| 1908 | 4,960 | 5,456,000 | ---- | ---- | 4,960 | 5,456,000 |
| 1909 | 5,540 | 6,094,000 | ---- | ---- | 5,540 | 6,094,000 |
| 1910 | 7,922 | 8,714,200 | ---- | ---- | 7,922 | 8,714,200 |
| 1911 | [3] 8,185 | 9,003,500 | ---- | ---- | 8,185 | 9,003,500 |
| 1912 | 5,824 | 6,406,400 | ---- | ---- | 5,824 | 6,406,400 |
| 1913 | 5,746 | 6,320,600 | ---- | ---- | 5,746 | 6,320,600 |
| 1914 | 5,205 | 5,725,500 | ---- | ---- | 5,205 | 5,725,500 |
| 1915 | 4,078 | 4,485,800 | ---- | ---- | 4,078 | 4,485,800 |
| 1916 | 4,656 | 5,121,600 | ---- | ---- | 4,656 | 5,121,600 |
| 1917 | 1,886 | 2,074,600 | ---- | ---- | 1,886 | 2,074,600 |
| 1918 | 1,804 | 1,984,400 | ---- | ---- | 1,804 | 1,984,400 |
| 1919 | 3,328 | 3,660,800 | ---- | ---- | 3,328 | 3,660,800 |
| 1920 | 2,275 | 2,502,500 | ---- | ---- | 2,275 | 2,502,500 |
| 1921 | 3,051 | 3,356,100 | ---- | ---- | 3,051 | 3,356,100 |
| 1922 | 1,621 | 1,783,100 | ---- | ---- | 1,621 | 1,783,100 |
| 1923 | 1,715 | 1,886,500 | 54 | 59,400 | 1,769 | 1,945,900 |
| 1924 | 2,175 | 2,392,500 | 145 | 159,500 | 2,320 | 2,552,000 |
| 1925 | 2,550 | 2,805,000 | 196 | 215,600 | 2,746 | 3,020,600 |
| 1926 | 1,055 | 1,160,500 | ---- | ---- | 1,055 | 1,160,500 |
| 1927 | [4] 844 | 928,400 | [4] 107 | 117,700 | [4] 951 | 1,046,100 |
| 1928 | 958 | 1,053,800 | 347 | 381,700 | 1,305 | 1,435,500 |
| 1929 | 1,483 | 1,631,300 | 486 | 534,600 | 1,969 | 2,165,900 |
| 1930 | 861 | 947,100 | 207 | 227,700 | 1,068 | 1,174,800 |
| 1931 | 1,211 | 1,332,100 | 40 | 44,000 | 1,251 | 1,376,100 |
| 1932 | 1,162 | 1,278,200 | 850 | 935,000 | 2,012 | 2,213,200 |
| 1933 | 2,227 | 2,449,700 | 204 | 224,400 | 2,431 | 2,674,100 |
| 1934 | 1,559 | 1,714,900 | 296 | 325,600 | 1,855 | 2,040,500 |
| 1935 | 1,152 | 1,267,200 | 578 | 635,800 | 1,730 | 1,903,000 |
| 1936 | 1,128 | 1,240,800 | 10 | 11,000 | 1,138 | 1,251,800 |

[1] Data from Pacific Fisherman Yearbooks, except for the noted exceptions.

[2] 1,100 pounds of round chinook and silver salmon are required to pack 1 tierce of 825 pounds of fish repacked and ready for shipment.

[3] 8,485 tierces in the Pacific Fisherman Yearbook giving data for that year.

[4] Burke Packing Co.'s coastal and Columbia River pack is lumped, and so is not included in this table.

## FROZEN SALMON

Salmon were doubtless preserved for local consumption and markets in the Columbia River region at a very early date by one of the simple processes of either allowing them to freeze outdoors in cold weather or covering them with cracked ice. However, this localized trade was given a broader field when the completion of a transcontinental railroad to Portland, Oreg., in 1883, made it possible for fresh fish to be shipped eastward from the Columbia River. These initial shipments were packed in crushed ice. The first departure from this practice occurred in 1888, at which time F. W. Schmidt and one of his brothers erected a fish-freezing plant at Portland, Oreg., the first of its kind on the Columbia. Apparently these fish were frozen by the ice and salt method. However, within a short time mechanical refrigeration came into use and the shipping of fresh salmon to points east of the Rocky Mountains from the Columbia River, which was begun in a small way by Schmidt, soon became an important business. The market finally extended to Europe, large quantities of frozen salmon being sent to Hamburg, Germany, and from there distributed over the continent.

Train service between Portland and Astoria, inaugurated May 17, 1898, permitted the cold-storage business to be carried on to an even larger extent than ever before by affording means of taking the frozen fish through to eastern markets without the necessity of transferring. Six cold-storage plants operated on the river in 1898.

TABLE 4.—*Columbia River frozen fish in pounds, 1911 to 1936* [1]

| Year | Salmon | Steelhead | Total | Year | Salmon | Steelhead | Total |
|---|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | | *Pounds* | *Pounds* | *Pounds* |
| 1911 | ---------- | [2] 2,850,000 | 2,850,000 | 1926 | 164,852 | 1,620,143 | 1,784,995 |
| 1912 | ---------- | 1,674,030 | 1,674,030 | 1927 | 198,116 | 1,097,187 | 1,295,303 |
| 1913 | 555,000 | 1,560,000 | 2,115,000 | 1928 | 270,540 | 1,049,098 | 1,319,638 |
| 1914 | 687,834 | 1,173,741 | 1,861,575 | 1929 | 200,000 | 1,251,425 | 1,451,425 |
| 1915 | 499,567 | 873,001 | 1,372,568 | 1930 | 262,522 | 1,279,737 | 1,542,259 |
| 1916 | 85,000 | 289,000 | 374,000 | 1931 | 293,500 | 1,310,708 | 1,604,208 |
| 1917 | 130,000 | 615,858 | 745,858 | 1932 | 437,234 | 538,795 | 976,029 |
| 1918 | 577,647 | 1,349,468 | 1,927,115 | 1933 | 528,789 | 747,563 | 1,276,352 |
| 1919 | 912,000 | 919,793 | 1,831,793 | 1934 | 290,493 | 905,916 | 1,196,409 |
| 1920 | 758,000 | 306,000 | 1,064,000 | 1935 | 766,907 | 459,847 | 1,226,754 |
| 1921 | 1,063,000 | 331,419 | 1,394,419 | 1936 | 128,922 | 629,596 | 758,518 |
| 1922 | 1,233,500 | 468,225 | 1,701,725 | | | | |
| 1923 | 100,000 | 918,450 | 1,018,450 | | | | |
| 1924 | 384,853 | 1,170,905 | 1,555,758 | | | | |
| 1925 | 650,263 | 1,911,844 | 2,562,107 | | | | |

[1] Data from the Pacific Fisherman Yearbooks.
[2] Not labeled steelhead, and may have included salmon.

At first only chinook salmon and steelheads were frozen, but in 1899 the freezers handled any species of salmon they could obtain. At the present time (1937) chinook and silver salmon and steelhead trout are the species frozen.

## SALMON BYPRODUCTS

In preparing fish for canning, mild curing, or the fresh-fish trade, there is a certain amount of offal consisting of heads, viscera, fins, etc., which is often profitably used in the manufacture of byproducts such as fish oil and meal. The Columbia River salmon fisheries present a rather favorable opportunity for this type of business because of the large volume and oily character of the fish handled.

Attempts to utilize these byproducts were begun at an early date in connection with the salt salmon industry. In the early years of that business, it was the custom to pack the salmon into the barrels under pressure so that they would not shake about within the container and become damaged when shipped for long distances in sailing vessels. This procedure of barreling under pressure forced a considerable quantity of oil out of the fish. In 1871, Mr. J. West began to collect and save the oil so pressed out, and by 1873 he was also extracting oil from the discarded salmon heads.

R. Watson & Co. put up about 9,000 gallons of fish oil in 5-gallon tins in 1875, which they extracted from salmon heads contracted for with canneries in the near vicinity. Their plant was temporary in 1875, but by the season of 1876 a building had been constructed to house their operations. Weber & Co. also completed a salmon-oil refinery in Upper Astoria early in May of that same year. Apparently the oil was pressed from the salmon in these early operations. The J. H. DeForce Oil Works was established in Astoria in 1878 and produced 8,000 gallons of oil, worth 22½ cents per gallon, during their first year of operation. They also made fertilizer from the offal, which sold for $20 per ton.

A short description of their plant and methods follows (Daily Astorian, August 7, 1883):

> The works were first located where the Seaside cannery now stands (Astoria) and were afterwards moved to a point up the river. Economy, however, demanded that the works should be below the canneries instead of above them, so last spring (1883) the works were moved to Smiths Point on the Youngs River.
>
> The building is 65 by 84 feet, stands on piles in the tide water, and is reached from the shore by a plank walk. The refuse from the canneries is brought to the works in boats from which it is raised by means of a tub and winch to a set of 16 tanks, each of the capacity of 2,000 salmon heads. Here the tank is charged for 5 hours with steam, then a gate in the bottom allows it to drop into a tank below. There are 8 of these tanks, each equal in capacity to 2 of the upper tanks. Here it is allowed to settle for 2 or 3 days, when the liquid portion is dipped into a set of small tanks, reboiled by steam and strained. It is then pumped into iron tanks 90 feet away from the main building where it is boiled by direct heat over a furnace. The oil then returns by gravitation to tanks inside the building, when it is allowed to settle and clear before being canned for market.

The expansion of the byproducts business was not rapid, for in 1895 there were only two plants operating, and their output amounted to but 30,000 gallons of oil and 150 tons of fish meal. In 1916 there were 20,000 gallons of oil and 100 tons of meal produced, while in 1935 39,985 gallons of oil and 282 tons of meal were produced. The minimum and maximum oil production in the intervening years was 14,000 and 65,000 gallons, that of meal 40 and 500 tons.

The methods and machinery in use improved during the years until, in 1931, one company installed California Manufacturing Co. equipment which supplanted the batch process which had been in use up to that time.

In recent years experimental work has been done on the production of special oils for medicinal purposes, which are now being produced and used because of their vitamin content. Some special oils are also extracted on the Columbia for the purpose of adding them to canned salmon before the cans are sealed. At the present time most of the fish meal is used for chicken and stock feed rather than fertilizer.

## FISHING METHODS AND GEAR

The various types of gear used in catching salmon, which support the most important fisheries of the Columbia, and the manner in which they are employed have been subject to change and improvement in the same fashion as have the other phases of the industry. The fishing methods of the Indians have been discussed in a previous section and need no further mention. Since the first white traders and settlers secured most of their salmon by purchase from the Indians, those fishing methods may be considered to overlap to some degree the period of the white man's occupation of the Columbia Basin. In fact there are at present a few locations where the Indians still catch salmon by methods very similar to those which they employed before the white man appeared.

The types of gear used in the Columbia River salmon fisheries have been and still are quite varied. They can be grouped or classified as gill nets, seines, traps, dip nets, squaw nets, set nets, troll lines, fish wheels, and purse seines. The latter two have been declared illegal and are not used on the Columbia at the present time. At this point it might be well to consider briefly the evolution, construction, and operation of each of these types of gear.

## GILL NETS

A drift gill net is essentially a piece of webbing which is allowed to drift with the current, the meshes of the webbing being of such size that the fish, when they encounter it, are able to penetrate as far as the region immediately posterior to their opercles and no farther than the region anterior to the dorsal fin. After forcing their bodies partly through the net the fish become caught and entangled by their projecting pectoral fins or opercles when they attempt to withdraw from the meshes. In order that the net may float at the proper depth and be extended to its full dimensions in in the water, lines are tied into both the top and bottom of the webbing. The line at the top of the net is fitted with corks which keep the upper or "cork" line afloat at or near to the surface of the water. The lower or "lead" line is provided with lead sinkers of sufficient weight to pull the webbing down to its full depth beneath the water. In a simple type of net these leads are not heavy enough to submerge the corks. One end of this net is usually made fast to a buoy and the other to the fisherman's boat. The net is then allowed to drift with the current, intercepting whatever fish swim into it in the course of their migrations.

The first gill nets used on the Columbia were of the simple construction just described. In 1853 Messrs. Hodgkins and Sanders operated the first gill net to be used on the Columbia. This net was brought from Bath, Maine, by Mr. Hodgkins and they used it in the vicinity of Oak Point. The second gill net of which we have any record was used by Rice and Reed in 1861. This net was 50 fathoms long, 3 fathoms deep, and was of 8-inch mesh. Mr. Rice made this net of twine which he spun on an old-fashioned spinning wheel from flax thread purchased locally.

When the pioneer salmon canning firm of Hapgood, Hume & Co. did their first fishing in 1866, they operated two gill nets, each being about 125 fathoms long and 23 feet deep. In 1871 the gill nets were still quite small, most of them being from 20 to 100 fathoms long. However, drift gill nets, 200 fathoms long and 20 feet deep, are mentioned in 1875, and some 225 fathoms in length were being made in 1876. The length of the nets increased rapidly for a few years, as is indicated by the fact that by 1880 nets from 300 to 350 fathoms long were in use. The length of gill nets has not increased from that time to the present as the nets now in use do not exceed 250 fathoms, which is a maximum set by law.

From the time when the first gill nets were made, up to the late eighties, the nets were made with mesh which measured from 8 to 8¼ inches when stretched. Until that time the fishery had been almost entirely for chinook salmon and, because of the fact that they are large fish, this size mesh was the most effective in producing large catches. However, in about 1890, the abundance of the chinook salmon began to decrease and a demand for chum, blueback, silver salmon, and steelhead trout arose. Therefore, the fishermen began to weave nets of smaller mesh with the idea of catching more of the smaller fish. But, by 1895, it was decided that the decrease in the number of chinooks taken, caused by the small mesh, was not compensated for by the increased catch of the other species, and the former practice of using large-mesh nets was resumed. In 1895 some nets of 10-inch mesh were in use. In later years, as the abundance of the chinook salmon declined still further and more fishing was done for the smaller and less desirable species, the fishermen began to use nets with various meshes according to the size or species of fish most abundant in the river at any particular time. At the present time these size variations are, as nearly as can be stated, as follows: During the spring season the majority of the fishermen use nets with 8½-inch mesh. Later in the summer the chinooks run larger and a 9¾-inch mesh net is preferable. In the fall a 7- to 8-inch mesh is often used for chum salmon and some 10 to 15 years ago, when the blueback salmon were still abundant, some nets of 4½-inch mesh were used during late June and July for that species. Bluebacks have become so few in number during late years that there are very few nets of this mesh on the river at the present time.

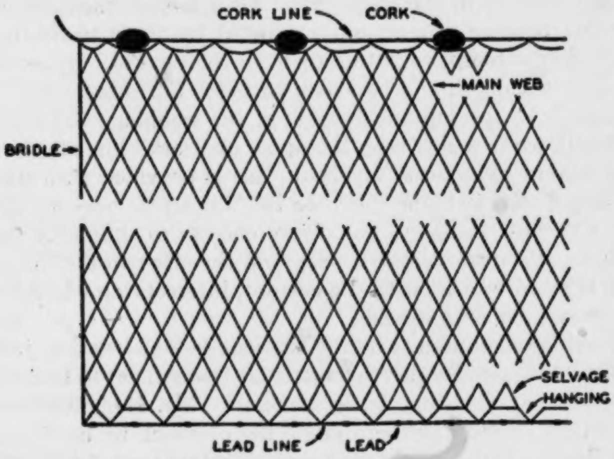

FIGURE 7.—Diagram of a gill net of the floater type.

An important development took place in gill-net fishing in about 1900 when the first "diver" nets began to appear. As has been pointed out previously, the original simple gill net floated with the cork line at the surface and the lead line extended to the depth of the net and usually at a considerable distance from the river bottom so that it did not touch it. However, this new diver type of net has the lead line weighted heavily enough so that the entire net is carried to the bottom. The lead line, however, is provided with just enough weight to cause it to touch the river bottom at short intervals and the cork line has sufficient buoyancy to keep the net extended vertically but not enough to maintain it at the surface. The advent of these nets was of considerable significance on the Columbia, since they produced large catches in the portion of the river extending above the broad estuary near its mouth. They increased in number rapidly, and at the present time practically all of the gill-net fishing above Tongue Point is carried on with diver nets. The portion of the river from Point Ellice to the mouth is still fished almost exclusively with floating nets, and some of these nets are used as far up the river as Tongue Point.

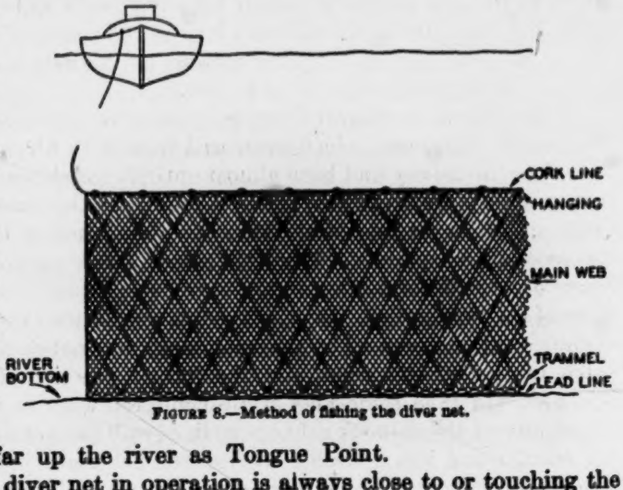

FIGURE 8.—Method of fishing the diver net.

Since the lead line of a diver net in operation is always close to or touching the bottom, these nets can only be used in places where the bottom is free from snags, sunken logs, and other debris. The Columbia River flows through well-forested land and there is considerable accumulation of debris in its channel. This condition caused the gill-net fishermen to organize themselves in small units according to the location in which they fished, for the purpose of removing the obstructions. These small organized groups are called "snag unions" and each one is limited to the men fishing a particular "drift"; a drift being a section of the river channel, usually 2 to 5 miles long, down which a net can be drifted without being picked up. It is an unwritten and well-enforced law that the men composing the snag union on a particular drift have exclusive fishing rights in that territory. These rights are often transferred from one person to another and are usually rigidly observed. The organization of the drifts also often includes a particular place from which the members start fishing. This is called the "towhead." The members of each group usually decide by lot the order in which they start fishing from the towhead on each day, because the men making the first few drifts usually have the best chances of securing good catches.

At about the same time at which the diver nets appeared on the Columbia, approximately 1900, the first departure from the original type of nets, consisting of a single curtain of webbing, took place. This new type was the trammel net. They gained in favor steadily and many of them are now in use in both the "floater" and "diver" varieties of nets. A full trammel consists of a curtain of large-mesh webbing hung on each side of an ordinary gill net. The large-mesh trammels are made of 16-thread soft cotton twine, or 15-, 18-, 21-, or 24-thread medium cotton twine, and the mesh may vary from 24 to 60 inches, stretched measure. In a full trammel net the trammels are tied to the "hangings" at the top of the net and to the hangings, or to the net itself, at the botton. There is some vertical and horizontal slack in a simple gill net having only one curtain of webbing. In a trammel net, which has more slack than the ordinary gill net, the slack is prevented from falling to the bottom of the net by tying the gill net and the trammels together about half the distance down the trammel.

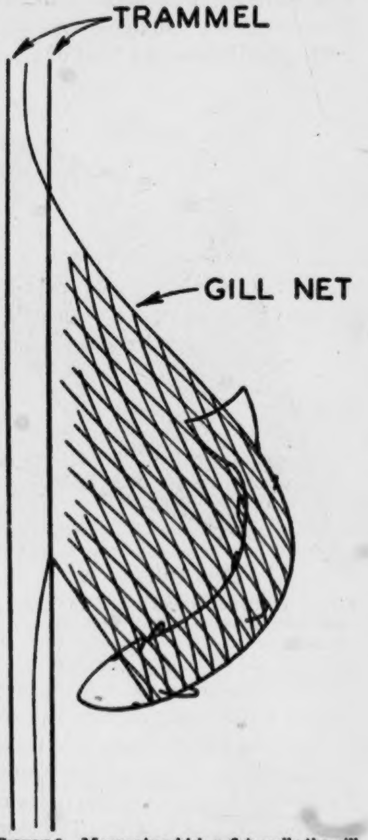

FIGURE 9.—Manner in which a fish pulls the gill-net webbing through a trammel mesh, thus forming a bag.

A trammel net is particularly effective in a fishery such as the Columbia, where there is a wide variation in the size of the fish caught. Small fish are caught by gilling in the small-mesh gill net, just as if it were of single mesh. Fish too large to gill in that mesh force the slack small mesh through the large-mesh trammels on the opposite side from wthich they approach the net. The result is that they find themselves in a bag or pouch formed by the small-mesh web which is constricted at the fishes' point of entrance by the large mesh trammels. They are usually unable to extricate themselves from this situation and so are caught. The principal disadvantage of the trammels is that large fish which are sluggish or wary will sometimes come in contact with the small mesh and then back out before they are bagged.

In about 1906 another modification of the gill net, known as the "combination" net, made its appearance. This term is applied to a net which is made up of at least two walls of linen web of different size mesh, with the larger mesh hung in front. These nets are usually divers and are most common in the upper portion of the river from St. Helens, to The Dalles, Oreg. At times the term "combination" is also applied to a net which has the upper portion fashioned of single big mesh and the lower section trammeled. These combination nets may include several sizes and types of webbing woven into a single net.

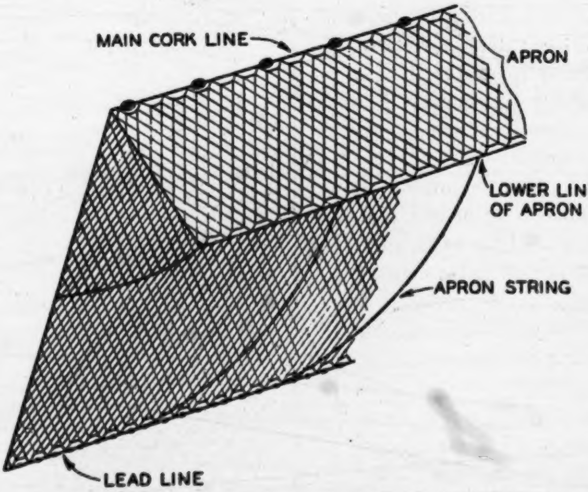

FIGURE 10.—Diver net with apron. To simplify the drawing the main web, selvage, and hangings are not shown behind the apron and the trammel mesh has been entirely omitted.

A further important addition to the construction and design of nets was the "apron," which came into use in about 1915. This might well be described as an auxiliary net which is suspended from the hangings on the side of the net only. Such a net is always fished with the apron on the side of the main net which is downstream, no matter whether it be a tidal or stream-flow current. The lower line of the apron is leaded either very lightly or not at all and consequently the action of the current causes it to hang at an angle on the downstream side of the main net. It is prevented from hanging in a position approaching the horizontal by strings which tie its lower line to the lead line of the main net. These strings are called tie or apron strings and are about 6 feet apart. The apron extends the whole length of the net, is from one-half to two-thirds the depth of the main net, and is made of 9- or 10-ply linen, usually with a 9- or 9½-inch mesh and a lower line of ⅜-inch cotton rope and may or may not be trammeled. Originally the apron was a single-mesh portion of the net designed to catch large fish which would strike diver nets and not gill, after which they would double-back and go over the net. Now the apron is often a trammel net and capable of catching any salmon that strikes it from either side. During recent years they have appeared on some floater nets in addition to their original use on the diver.

Up to about 1890 the cannery operators made and owned the nets, furnishing them to the fishermen. Since that time, however, the fishermen have made and owned their own nets. It is only natural that each fisherman should have his own ideas of the type of net which is most efficacious in his particular case and, since they usually make the nets themselves, these ideas are put into practice, with the result that we find almost every conceivable combination of the standard nets. There are diver nets with trammels and plain aprons; others with trammeled aprons; combination divers with two walls of web, with and without aprons; nets which are part large- and part small-mesh in the same wall of webbing; and nets which are partly trammeled and partly plain mesh. Therefore, it is plainly indicated that there is no standard type of net for the Columbia, but one fact which is evident is that all of these changes in net construction have been for the purpose of improving the fishing qualities of the nets, and it appears certain that the efficiency of the nets has improved during the entire development of the fishery.

Drift gill nets are the most important type of gear used on the Columbia in point of number of units employed and size of catch produced. Approximately 59 percent of the total catch of salmon and steelheads made on the river from 1927 to 1934, inclusive, was made by this gear. Table 5 shows the gill-net catches made during the years when the United States Bureau of Fisheries conducted surveys of the Columbia River fisheries—from 1889 to 1934, inclusive, tabulated by species. This tabulation indicates that the gill-net catch during those years consisted of 83.0 percent chinook salmon, 5.4 percent chum salmon, 5.3 percent steelhead trout, 4.9 percent silver salmon, and 1.4 percent blueback salmon. From 1927 to 1934, inclusive, the catch of the drift gill nets constituted 64.0 percent of the total chinook take on the river, 32.5 percent of the steelhead catch, 44.1 percent of the blueback catch, 36.3 percent of the silver salmon catch, and 68.8 percent of the chum salmon total.

TABLE 5.—*Salmon and steelhead catch of the drift gill nets, by species, on Columbia River, 1889–92, 1895, 1899, 1904, 1909, 1915, and 1925 to 1934, inclusive, and the percent that each species forms of the total for the year* [1]

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1889 | 225,205 | 1.8 | 12,060,375 | 95.6 | ---------- | ----- | ---------- | ----- | 324,420 | 2.6 | 12,610,000 |
| 1890 | 548,135 | 3.5 | 14,596,375 | 93.4 | ---------- | ----- | ---------- | ----- | 482,285 | 3.1 | 15,626,795 |
| 1891 | 207,735 | 1.2 | 16,554,025 | 96.6 | ---------- | ----- | 6,853 | 0 | 378,555 | 2.2 | 17,147,168 |
| 1892 | 580,810 | 3.7 | 14,608,545 | 91.9 | ---------- | ----- | 5,000 | 0 | 704,710 | 4.4 | 15,899,065 |
| 1895 | 93,010 | .4 | 19,995,643 | 76.6 | 705,430 | 2.7 | 3,234,644 | 12.4 | 2,057,193 | 7.9 | 26,085,920 |
| 1899 | 146,787 | 1.0 | 12,487,206 | 83.7 | 348,000 | 2.3 | 1,404,282 | 9.4 | 535,755 | 3.6 | 14,922,030 |
| 1904 | 62,640 | .3 | 21,134,377 | 90.8 | 528,900 | 2.3 | 1,228,135 | 5.3 | 314,516 | 1.3 | 23,268,568 |
| 1909 | 8,350 | .1 | 11,958,512 | 86.6 | 542,472 | 3.9 | 792,774 | 5.7 | 515,940 | 3.7 | 13,818,048 |
| 1915 | 121,353 | .5 | 17,284,299 | 75.2 | 1,590,640 | 6.9 | 2,529,909 | 11.0 | 1,472,907 | 6.4 | 22,999,108 |
| 1925 [2] | 30,625 | .5 | 5,003,926 | 79.0 | 522,900 | 8.2 | 281,540 | 4.4 | 497,700 | 7.9 | 6,336,691 |
| 1926 | 793,001 | 5.2 | 11,968,640 | 78.7 | 678,805 | 4.5 | 549,786 | 3.6 | 1,225,784 | 8.0 | 15,236,016 |
| 1927 [3] | 260,237 | 1.3 | 14,984,410 | 75.3 | 2,687,157 | 13.5 | 746,068 | 3.7 | 1,256,822 | 6.3 | 19,935,294 |
| 1928 | 160,945 | 1.1 | 9,559,285 | 66.7 | 3,376,560 | 23.6 | 466,799 | 3.3 | 758,281 | 5.3 | 14,321,870 |
| 1929 | 425,359 | 3.3 | 9,199,633 | 72.1 | 1,458,992 | 11.4 | 761,190 | 6.0 | 925,081 | 7.2 | 12,770,255 |
| 1930 | 237,066 | 1.9 | 10,486,492 | 82.5 | 438,490 | 3.4 | 540,556 | 4.3 | 999,718 | 7.9 | 12,702,322 |
| 1931 | 92,836 | .6 | 12,723,561 | 87.1 | 745,334 | 5.1 | 236,884 | 1.6 | 810,377 | 5.6 | 14,608,992 |
| 1932 | 50,320 | .4 | 10,583,929 | 83.6 | 859,332 | 6.8 | 352,624 | 2.8 | 815,847 | 6.4 | 12,662,052 |
| 1933 | 70,519 | .5 | 12,016,294 | 83.0 | 905,224 | 6.2 | 522,158 | 3.6 | 960,961 | 6.7 | 14,484,156 |
| 1934 | 160,100 | 1.2 | 10,793,000 | 80.4 | 894,800 | 6.7 | 849,300 | 6.3 | 728,300 | 5.4 | 13,425,500 |
| Total | 4,275,033 | 1.4 | 248,018,527 | 83.0 | 16,283,036 | 5.4 | 14,509,102 | 4.9 | 15,774,152 | 5.3 | 298,859,850 |

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[1] Data for the following years not separated into set and drift gill nets, hence includes all gill nets: 1889–92, 1895, 1899, 1904, 1909, 1915, and 1926.

[2] Data for 1925 includes Washington Columbia River district only.

[3] Oregon data for years 1927–32, inclusive, not separated into catches of drift and set gill nets. Oregon values for drift and set gill nets computed from Washington data and corrected for differences in number of gear.

TABLE 6.—*Average annual catch by species and gear, 1927 to 1934, inclusive*

| Gear | Blueback, average annual catch | | Chinook, average annual catch | | Chum, average annual catch | | Silver, average annual catch | | Steelhead, average annual catch | | Average annual total catch | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Per cent |
| Traps | 68,819 | 16.6 | 2,684,196 | 15.2 | 544,650 | 26.4 | 886,459 | 57.6 | 976,677 | 34.9 | 5,160,801 | 21.1 |
| Seines | 62,937 | 15.2 | 2,842,829 | 16.1 | 65,944 | 3.2 | 80,324 | 5.2 | 697,895 | 24.9 | 3,749,929 | 15.3 |
| Drift gill nets | 182,173 | 44.1 | 11,293,326 | 64.0 | 1,420,736 | 68.8 | 559,522 | 36.3 | 908,048 | 32.5 | 14,363,805 | 58.7 |
| Set gill nets | 14,331 | 3.5 | 157,008 | .9 | 25,880 | 1.3 | 9,812 | .6 | 110,983 | 4.0 | 318,014 | 1.3 |
| Wheels [1] | 64,932 | 15.7 | 324,473 | 1.8 | 790 | 0 | 392 | 0 | 34,064 | 1.2 | 424,651 | 1.7 |
| Dip nets | 20,116 | 4.9 | 358,973 | 2.0 | 6,515 | .3 | 4,461 | .3 | 70,105 | 2.5 | 460,170 | 1.9 |
| Total | 413,308 | 100.0 | 17,660,805 | 100.0 | 2,064,515 | 100.0 | 1,540,970 | 100.0 | 2,797,772 | 100.0 | 24,477,370 | 100.0 |

[1] Fish wheels were outlawed in Oregon during the fishing season of 1927.

## TRAPS

During the development of the fisheries of the Columbia there have been two different varieties of gear commonly designated as traps. The first of these to appear on the river was the slat, or wooden trap, and the second the modern pile-and-webbing trap, or pound net. Although the wooden trap was the first of these two types of gear on the river, it was entirely supplanted by the pile-and-webbing trap at an early date. Since these two varieties of gear are very similar in plan of construction and theory of fishing, and the pile-and-web trap superseded the wooden structure in the Columbia River fisheries, it appears advantageous to discuss these two varieties of gear in close relation to each other.

### WOODEN TRAPS

The typical wooden trap consisted of a lead constructed of piling and slats or pickets, resembling a fence, which was usually built from the river bank to a point some 200 to 600 feet from the shore. On the offshore end of the lead the portion of the trap which actually caught the fish was also made entirely of wooden slats and piling and was built with the wall of the trap farthest from shore projecting downstream from the lead and hooking in toward the shore in order to intercept fish which might follow the lead to the end and endeavor to go around it. The remainder of this part of the trap consisted of two arrow-shaped "hearts" which finally led, by means of a funnel-shaped passage, into the "crib" or enclosure where the fish were impounded. These traps were built to catch fish which approached from a downstream direction only and their efficiency depended on the fact that salmon, when making their upstream migration, will persevere in attempts to continue in that direction even when confronted by apparently impassable obstacles. The hearts and pot of such a trap were built on shore and floated out to the proper position at the end of the lead where they were ballasted with stone and sunk to the bottom.

This type of gear was considered by early observers to be a modification of the pole-and-brush weirs which were used by the Indians before the arrival of the white men. The first two traps constructed in 1853 by Hodgkins and Sanders, near Oak Point, were quickly destroyed by freshets but a successful one was built in 1854. Wooden traps were in use in significant numbers soon after the beginning of the salmon-canning industry, about 1868 or 1870, and for a time they were of some importance in the fishery. But their place was soon taken by the modern pile-and-web structures so that by 1889 all of the wooden traps were concentrated in an area between a point 15 miles above Astoria, Oreg. and the lower end of Sauvies Island, a distance of some 40 or 50 miles, and by about 1894 the wooden traps had disappeared entirely from the river.

### MODERN TRAPS

The general plan or layout of a modern trap,[4] which is shown in figure 11, is very similar to that of the wooden traps. This gear consists of a lead which may be from 300 to 600 feet in length and which terminates in a heart from which the fish are lead into the pot and then into the spiller, a small enclosure, from which the salmon are brailed or gaffed into the boats receiving them. The pot is merely a small compartment connected with the heart from which the fish can pass through a tunnel into the spiller. A few traps have two spillers, one at either end of the pot. The lead is constructed of tarred cotton webbing supported by piling driven into the river bottom. The heart and spiller are constructed in the same manner and of the same materials.

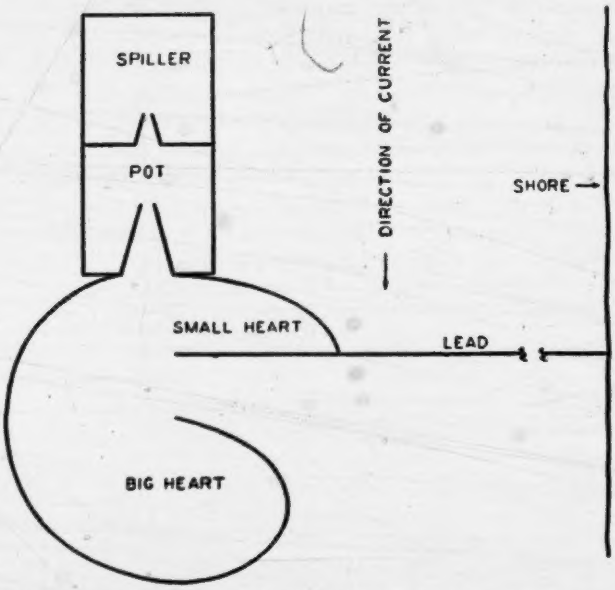

FIGURE 11.—Columbia River fish trap. This style of trap is typical of the middle river. Some traps used on the lower river have a heart, pot, and spiller on both sides of the lead.

In the early days of the fishery, from about 1885 to 1890, galvanized wire netting was sometimes used instead of the tarred net webbing. The wire netting, however, is used very little in the Columbia at present because it corrodes in the brackish water in the lower river and the fishermen believe that the salmon do not lead or follow it as well as tarred webbing. Also, in about 1890, some of the traps above Baker Bay had leads made of wooden slats. This type of construction is no longer found in the present traps. At the beginning of the trap fishery most of the piling was hand driven and much of it was removed for the winter after the end of the fishing season.

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[4] Although the modern Columbia River traps were originally designed as direct copies of the pound nets of the Great Lakes and are technically a form of pound net at the present time, they are designated as traps in this publication because that is the term commonly used for this type of gear on the Pacific coast from Oregon to Alaska.

The piling is now all driven by power operated piledrivers and it is left in continuously. Larger piling and sturdier construction is used in the modern traps than in those built during earlier years.

In May 1879, Mr. O. P. Graham, formerly of Green Bay, Wis., built the first modern trap to be used in the Columbia River. This gear was similar to the pound nets in use on the Great Lakes at that time and from all reports was extremely successful in taking salmon. Therefore, this type of gear increased rapidly in numbers and many fishermen left the Great Lakes and came to the Columbia to take part in this new fishery. By 1885 there were 105 traps in operation on the Columbia and within the next near this number was increased to 154. During the year 1889 there were 121 modern traps in Baker Bay, and all of the wooden traps were concentrated in the section of the river between a point some 15 miles above Astoria, Oreg., and the lower end of Sauvies Island. By about 1894 the modern traps had completely replaced the wooden traps and that form of gear dropped out of the Columbia River fishery entirely. During the fishing season of 1934 there were 238 traps operated on the river. However, in 1935 a law went into effect which prohibited the use of this gear in the State of Washington. Since 211 of the traps operated on the river were on the Washington side, and only 27 were in Oregon, it is evident that this law sharply curtailed the number of units of this type of gear operated.

TABLE 7.—*Salmon and steelhead catch of the traps, by species, on Columbia River, 1889–92, 1895, 1899, 1904, 1909, 1915, and 1925 to 1934, inclusive* [1]

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1889 | 287,555 | 7.1 | 3,177,500 | 78.1 | ---------- | ------ | ---------- | ------ | 604,145 | 14.8 | 4,069,200 |
| 1890 | 462,950 | 8.0 | 4,386,125 | 75.9 | ---------- | ------ | ---------- | ------ | 930,120 | 16.1 | 5,779,195 |
| 1891 | 375,780 | 5.8 | 5,090,175 | 78.9 | ---------- | ------ | ---------- | ------ | 985,264 | 15.3 | 6,451,219 |
| 1892 | 1,454,120 | 16.4 | 5,537,975 | 62.3 | ---------- | ------ | ---------- | ------ | 1,896,590 | 21.3 | 8,888,685 |
| 1895 | 266,822 | 2.4 | 5,596,902 | 50.4 | 926,550 | 8.3 | 3,015,472 | 27.1 | 1,312,475 | 11.8 | 11,118,221 |
| 1899 | 499,522 | 7.7 | 2,717,674 | 41.6 | 759,026 | 11.6 | 2,046,039 | 31.3 | 508,928 | 7.8 | 6,531,189 |
| 1904 | 147,070 | 1.6 | 3,283,522 | 36.6 | 2,035,750 | 22.7 | 2,796,867 | 31.1 | 717,827 | 8.0 | 8,981,036 |
| 1909 | 141,265 | 3.2 | 1,198,383 | 27.2 | 931,564 | 21.2 | 1,602,581 | 36.4 | 527,071 | 12.0 | 4,400,864 |
| 1915 | 105,817 | 1.2 | 5,691,460 | 63.0 | 634,424 | 7.0 | 1,463,901 | 16.2 | 1,133,146 | 12.6 | 9,028,748 |
| 1925 [2] | 25,115 | .5 | 2,808,369 | 56.0 | 542,331 | 10.8 | 1,002,200 | 20.0 | 638,960 | 12.7 | 5,016,975 |
| 1926 | 130,447 | 1.8 | 3,976,357 | 55.1 | 276,886 | 3.8 | 1,416,113 | 19.6 | 1,419,150 | 19.7 | 7,218,953 |
| 1927 | 46,725 | .7 | 3,205,639 | 50.4 | 1,192,306 | 18.8 | 970,601 | 15.3 | 938,568 | 14.8 | 6,353,839 |
| 1928 | 42,973 | .8 | 2,514,071 | 45.4 | 1,240,334 | 22.4 | 838,644 | 15.2 | 896,841 | 16.2 | 5,532,863 |
| 1929 | 114,563 | 2.1 | 2,411,363 | 45.0 | 328,381 | 6.1 | 1,417,479 | 26.5 | 1,086,061 | 20.3 | 5,357,847 |
| 1930 | 105,739 | 1.8 | 2,639,565 | 45.2 | 409,371 | 7.0 | 1,323,830 | 22.7 | 1,357,606 | 23.3 | 5,836,111 |
| 1931 | 60,759 | 1.1 | 2,713,748 | 50.8 | 428,921 | 8.0 | 860,541 | 16.1 | 1,278,800 | 24.0 | 5,342,769 |
| 1932 | 82,102 | 2.1 | 2,396,091 | 60.7 | 347,238 | 8.8 | 418,594 | 10.6 | 704,724 | 17.8 | 3,948,749 |
| 1933 | 41,290 | 1.0 | 2,653,194 | 66.0 | 187,046 | 4.7 | 553,583 | 13.8 | 584,418 | 14.5 | 4,019,531 |
| 1934 | 56,400 | 1.1 | 2,939,900 | 60.1 | 223,600 | 4.6 | 708,400 | 14.5 | 966,400 | 19.7 | 4,894,700 |
| Total | 4,447,014 | 3.7 | 64,938,013 | 54.7 | 10,463,728 | 8.8 | 20,434,845 | 17.2 | 18,487,094 | 15.6 | 118,770,694 |

[1] Data for the wooden slat traps is available for the years 1889–92, but is not included with the data for modern traps.

[2] Washington landings only.

From 1927 to 1934 the traps took an average of approximately 21 percent of the total catch of salmon and steelhead trout on the Columbia, so it is apparent that they were an important type of gear, being second only to drift gill nets in production during that period. By referring to table 7 it can be seen that from 1889 to 1934, during the years when the United States Bureau of Fisheries made canvasses of the Columbia River fisheries, the catches of the traps averaged 54.7 percent chinook salmon, 15.6 percent steelhead trout, 17.2 percent silver salmon, 8.8 percent chum salmon, and 3.7

percent blueback salmon. From 1927 to 1934, inclusive, the traps accounted for 15.2 percent of the chinook salmon catch, 34.9 percent of the steelhead trout catch, 16.6 percent of the blueback salmon, 57.6 percent of the silver salmon, and 26.4 percent of the chum salmon.

## HAUL SEINES

Seines are, without doubt, one of the oldest types of gear employed in the Columbia River salmon fisheries. In a previous section on Indian fishing methods and gear, the use of seines by the original inhabitants before the appearance of white men was described, and it is evident that their use has continued without interruption from the Indian fishing through the intermediate period of the fishery and up to the present time. In the year 1934 there were 57 seines operated on the river. Of this total, 33 were on the Oregon side of the river and 24 on the Washington shore. A legislative (initiative petition) measure of the State of Washington, which became effective in 1935, prohibits the use of seines on that side of the river.

In common with other varieties of fishing apparatus, the seines have undergone a process of change tending toward greater size and efficiency as the fishery has become older. At the inception of the industry the seines were apparently quite small and hauled by hand, and were constructed so that the seine was deepest in the "bunt" or middle portion. In 1882 the seines were still only 50 to 70 fathoms long and deepest at the bunt. By 1888, however, their usual length had been increased to between 200 and 300 fathoms and they were being made with the offshore, or outer wings, the deepest part of the net. In 1908 some seines 400 fathoms or more long were in use and at present they range from 200 to 425 fathoms in length. The outer wing of the net is still the deepest part, with the beach end the shallowest. This type of seine has an advantage in that it permits the "lead" line of the offshore wing to remain on the bottom when it is swung out into deep water.

Most of the seines are now pulled by horses, sometimes two double teams on the beach, or tail end, and five on the offshore, or head end. The seines are laid out from skiffs towed by launches and the average size of the seine crews is 24 men.

A seine is an exceedingly simple piece of fishing apparatus. Essentially it consists of one curtain of webbing attached at its upper edge to a line provided with corks, called the cork line, which keeps that edge afloat at the surface, and to a weighted or lead line at its lower edge, which keeps the net extended and in contact with the stream bed. Lines are attached to both ends for use in pulling the net. It is fished by the process of leaving one end on shore while carrying the seine out in a skiff towed by a launch, from which it is thrown off or "laid out" with the current in a semicircle with the outer end finally being pulled back upon the shore. The entire net is then pulled up on the beach, dragging in whatever fish may have been encircled as the net was laid out.

As previously stated, a present-day seine may be from 200 to 425 fathoms long with the shore end 5 fathoms deep and the head end 7 fathoms deep. These are stretched depths as the net is fished, the actual depths being about one-third greater. The 6-, 7-, and 8-inch-mesh webbing is made of 18-ply cotton twine, the 5-inch mesh of 21-ply, and the 4-inch mesh of 30-ply thread. This may vary between different nets. The mesh used in the wings is usually 8 inches, stretched measure, with 4-inch mesh in the bunt and 5-, 6-, and 7-inch mesh between the wings and the bunt.

Since the time when the fisheries of the Columbia were established as an important industry, seining operations have been confined largely to the section of the river extending from Celilo Falls to the mouth, with the more important operations carried on in the lower 70 miles of the stream. The seining grounds, where the most effective operations are carried on, are the low sandy spits and islands in the lower, tidal portion of the river channel. Many of these are completely inundated at high tide, but because of their location at points where the salmon are numerous and their sloping sandy beaches, which are ideal for hauling the nets, they are excellent for seining purposes.

From about 1870 to sometime shortly after 1900 there was considerable seining done in that part of the Snake River extending some 70 miles or more downstream from the confluence with the Boise River. This was done with small seines, from 40 to 65 fathoms in length, operated by crews of 3 or 4 men with perhaps 1 horse and a large skiff. The seines were made deep in the middle and shallow at both wings. Chinook salmon and steelhead trout were practically the only species caught and the fish were either sold fresh locally or iced and shipped into the intermountain regions.

Apparently this fishery was discontinued because of an increasing scarcity of salmon and, since most of the seining sites were located at places where the fish were spawning and where conditions were such that practically every salmon which reached those spawning grounds could be caught, it would not be surprising if the races supporting those runs were practically exterminated.

TABLE 8.—*Salmon and steelhead catch of haul seines, by species, on Columbia River, 1889–92, 1895, 1899, 1904, 1909, 1915, and 1925 to 1934, inclusive*

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1889 | 29,725 | 1.0 | 2,213,350 | 77.7 | ------ | ------ | ------ | ------ | 606,980 | 21.3 | 2,850,055 |
| 1890 | 82,710 | 3.9 | 1,612,550 | 74.9 | ------ | ------ | ------ | ------ | 457,140 | 21.2 | 2,152,400 |
| 1891 | 52,885 | 2.6 | 1,627.125 | 80.9 | ------ | ------ | 5,999 | 0.3 | 325,610 | 16.2 | 2,011,619 |
| 1892 | 612,920 | 24.2 | 1,379,085 | 54.4 | ------ | ------ | 10,000 | .4 | 533,782 | 21.0 | 2,535,787 |
| 1895 | 369,094 | 4.4 | 3,922,351 | 47.2 | 611,761 | 7.4 | 2,057,864 | 24.8 | 1,342,187 | 16.2 | 8,303,257 |
| 1899 | 312,916 | 10.4 | 1,820,265 | 60.4 | 33,798 | 1.1 | 462,050 | 15.3 | 385,549 | 12.8 | 3,015,578 |
| 1904 | 142,705 | 3.1 | 3,580,511 | 78.0 | 1,189 | 0 | 137,593 | 3.0 | 731,624 | 15.9 | 4,593,622 |
| 1909 | 110,503 | 3.6 | 1,392,377 | 44.7 | 24,000 | .8 | 506,439 | 16.3 | 1,078,118 | 34.6 | 3,111,437 |
| 1915 | 167,318 | 2.3 | 5,504,774 | 77.1 | 139,957 | 2.0 | 145,308 | 2.0 | 1,182,583 | 16.6 | 7,139,940 |
| 1925 [1] | 11,500 | 1.6 | 563,868 | 78.9 | 16,839 | 2.4 | 13,770 | 1.9 | 108,560 | 15.2 | 714,537 |
| 1926 | 310,894 | 5.3 | 4,160,421 | 71.7 | 116,866 | 2.0 | 90,117 | 1.6 | 1,123,771 | 19.4 | 5,802,069 |
| 1927 | 50,772 | 1.3 | 2,760,207 | 70.1 | 42,137 | 1.1 | 110,138 | 2.8 | 974,935 | 24.7 | 3,938,249 |
| 1928 | 68,399 | 1.6 | 3,360,747 | 76.0 | 194,729 | 4.4 | 120,809 | 2.7 | 676,675 | 15.3 | 4,421,359 |
| 1929 | 87,977 | 2.8 | 2,080,457 | 67.1 | 134,803 | 4.4 | 106,440 | 3.4 | 689,842 | 22.3 | 3,099,519 |
| 1930 | 114,750 | 3.1 | 2,785,097 | 74.5 | 38,274 | 1.0 | 66,635 | 1.8 | 734,944 | 19.6 | 3,739,700 |
| 1931 | 49,049 | 1.1 | 3,591,697 | 81.1 | 2,960 | .1 | 15,473 | .3 | 768,909 | 17.4 | 4,428,088 |
| 1932 | 24,126 | .9 | 2,156,578 | 78.5 | 30,561 | 1.1 | 28,001 | 1.0 | 507,642 | 18.5 | 2,746,908 |
| 1933 | 19,923 | .6 | 2,312,988 | 74.9 | 60,986 | 2.0 | 106,995 | 3.5 | 586,414 | 19.0 | 3,087,306 |
| 1934 | 89,500 | 2.0 | 3,693,800 | 81.4 | 23,100 | .5 | 88,100 | 1.9 | 643,800 | 14.2 | 4,538,300 |
| Total | 2,707,661 | 3.8 | 50,519,308 | 70.0 | 1,471,960 | 2.0 | 4,071,731 | 5.6 | 13,459,070 | 18.6 | 72,229,730 |

[1] Washington landings only.

During the period 1927 to 1934, inclusive, the seines took approximately 15 percent of the total catch of salmon and steelhead trout made on the Columbia River. Table 8 indicates that during the years when data are available the catch of the seines consisted of 70.0 percent chinook salmon, 18.6 percent steelheads, 5.6 percent silver salmon, 2.0 percent chum salmon, and 3.8 percent bluebacks. The catch of the seines amounted to 16.1 percent of the total chinook catch, 24.9 percent of the steelhead catch, 15.2 percent of the blueback catch, 5.2 percent of the silver salmon catch, and 3.2 percent of the chum take from 1927 to 1934, inclusive.

### FISH WHEELS

Fish wheels were unquestionably one of the most ingenious labor-saving pieces of apparatus ever invented for the purpose of capturing fish. This variety of gear was first operated on the Columbia River in 1879 by Mr. S. W. Williams and his brother, who patented the device. However, Cobb (1931), states that they were not originators of fish wheels since this gear had been used previously on the Roanoke River in North Carolina and the Yukon River in Alaska.

Cobb (1931) gives a general description of fish wheels which follows:

> Fish wheels are of two kinds, the floating or scow wheel, which can be moved from point to point if need be, and the shore wheel which is a fixed apparatus. They operate in exactly the same manner, however. The stationary wheel is located along the shore in a place where experience has shown that the salmon pass. Here an abutment is built of wood and stone, high enough to protect it from an ordinary rise in the river. To this is attached the necessary framework for holding the wheel. The latter is composed of large scoop-shaped dip nets made of galvanized-iron wire netting with a mesh of 3½ to 4 inches. These nets are the buckets of the wheel and they are so arranged on a horizontal axis that the wheel is kept in constant motion by the current, and thus picks up any fish which come within its sweep. The nets are fixed at such an angle that as they revolve their contents fall into a box chute through which the fish slide into a large bin on the shore. The wheels range in size from 9 to 32 feet in diameter and from 5 to 15 feet in width and cost from $1,500 to $8,000, the average being about $4,000. A number of them have long leaders of piling running out into the river, which aid in leading the salmon into the range of the wheel.
>
> The scow wheel consists of a large square-ended scow that is usually decked at one end and open at the other. Several stanchions, some 8 to 10 feet high, support a framework upon which an awning is spread to protect the fish from the sun's rays and the crew from the elements. To one end of the scow are fastened two upright posts, which are guyed by wooden supports, while projecting from the same end is the framework which supports the wheel, the latter being constructed in the same way as the stationary wheel, but on a smaller scale. In operation the scow is anchored with the wheel end pointing downstream, and as the wheel is revolved by the current, the fish caught fall from the net into a box chute, through which they slide into the scow. As stationary wheels can be used only at certain stages of water, the scow wheel is a necessary substitute to be used at such times as the former cannot be operated, or in places where it is not feasible to build a stationary wheel.

The region in which wheels were operated lies between a point some 30 miles above Portland and Celilo Falls. In order to be successful a wheel must necessarily be located at a point where the channel and currents cause the salmon to concentrate in their upstream migrations. Such sites are not available in the wide, slowly moving, lower portion of the river. The efficiency of the fixed wheels was influenced to a great extent by the height of the river. Some wheels being placed in locations where the fish were abundant in high water were not able to fish at all at low-water stages, and wheels which made large catches under low-water conditions might be entirely flooded out during a freshet. The scow wheels were, to a certain extent, influenced by water conditions, but they could be moved as various locations became more or less desirable.

By virtue of their patent Mr. Williams and his brother had a monopoly of the wheels from 1879 to 1881, inclusive. Their first wheel was located near the Cascades, just above Bonneville, Oreg., and was purchased by the Warren Canning Co. It is reported to have caught from 1,500 to 4,000 salmon and steelheads daily during the fishing season of 1881. In 1882 there were 4 wheels in operation, some of which were apparently very successful, since 1 of these was credited with taking 6,400 large fish suitable for canning in 1 day. By 1883 there were 5 wheels and they were increased to 40 in 1889, 57 in 1892, and 76 in 1899. In later years the number of wheels declined until in 1927 there were only 20 wheels in Oregon and 34 in Washington. Immediately after that time legislative action of the State of Oregon, which became effective during the fishing season of 1927, greatly curtailed the number of fish wheels by abolishing them from the Oregon side of the river. In 1934 there were 27 wheels in use on the Washington side of the river. Similar legislation went into effect in Washington in 1935 so that at the present time there are no wheels being operated on the Columbia.

After the fish wheels were prohibited in Oregon they were not a significant factor in the production of the total catch of the river, only 1.7 percent of the total catch of salmon and steelheads having been made by that gear in the period from 1927 to 1934, inclusive. Table 9 shows that during the years from 1889 to 1934, when statistical surveys were made by the United States Bureau of Fisheries, the catch of the wheels was composed of 33.0 percent bluebacks, 44.6 percent chinooks, 0.1 percent chums, 4.4 percent slvers, and 17.9 percent steelheads. During the period 1927 to 1934, inclusive, the wheels took 1.8 percent of the total chinook salmon catch, 1.2 percent of the steelheiad trout catch, 15.7 percent of the blueback salmon catch, and an insignificant amount of the chum and silver salmon catch.

**TABLE 9.**—*Salmon and steelhead catch of the wheels, by species, on Columbia River, 1889–92, 1895, 1899, 1904, 1909, 1915, and 1925 to 1934, inclusive*

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1889 | 930,772 | 57.8 | 551,450 | 34.3 | | | 48,280 | 3.0 | 78,090 | 4.9 | 1,608,592 |
| 1890 | 3,684,620 | 50.0 | 2,779,370 | 37.8 | | | 42,112 | .6 | 850,400 | 11.6 | 7,356,502 |
| 1891 | 583,395 | 31.5 | 831,693 | 44.8 | | | 53,550 | 2.9 | 385,890 | 20.8 | 1,854,528 |
| 1892 | 2,301,755 | 41.2 | 1,566,745 | 28.1 | | | 308,889 | 5.5 | 1,407,100 | 25.2 | 5,584,489 |
| 1895 | 563,758 | 19.5 | 1,206,089 | 41.8 | 5,756 | 0.2 | 113,963 | 3.9 | 998,103 | 34.6 | 2,887,669 |
| 1899 | 759,877 | 26.9 | 1,581,644 | 56.0 | 7,843 | .3 | 35,162 | 1.2 | 439,181 | 15.6 | 2,823,707 |
| 1904 | 453,956 | 22.0 | 1,060,871 | 51.4 | | | 153,836 | 7.4 | 396,136 | 19.2 | 2,064,799 |
| 1909 | 949,165 | 29.3 | 1,091,751 | 33.7 | | | 603,453 | 18.7 | 592,819 | 18.3 | 3,237,188 |
| 1915 | 131,431 | 13.1 | 778,033 | 77.8 | | | 8,148 | .8 | 82,977 | 8.3 | 1,000,589 |
| 1925 [1] | 110,570 | 13.1 | 376,602 | 44.8 | | | 68,680 | 8.2 | 285,320 | 33.9 | 841,172 |
| 1926 | 62,012 | 8.8 | 448,419 | 64.0 | | | 7,780 | 1.1 | 182,907 | 26.1 | 701,118 |
| 1927 [2] | 74,841 | 9.8 | 637,959 | 83.6 | | | 80 | | 49,972 | 6.6 | 762,852 |
| 1928 | 30,480 | 9.2 | 266,041 | 80.1 | | | 70 | | 35,640 | 10.7 | 332,231 |
| 1929 | 28,093 | 11.5 | 194,887 | 79.5 | 5,293 | 2.2 | 206 | .1 | 16,444 | 6.7 | 244,923 |
| 1930 | 54,934 | 21.2 | 173,537 | 67.0 | 1,024 | .4 | 2,596 | 1.0 | 26,861 | 10.4 | 258,952 |
| 1931 | 21,947 | 9.5 | 200,086 | 87.0 | | | | | 7,988 | 3.5 | 230,021 |
| 1932 | 23,151 | 4.5 | 449,631 | 87.8 | | | 54 | | 39,510 | 7.7 | 512,346 |
| 1933 | 204,406 | 27.3 | 478,444 | 64.0 | | | 126 | | 65,200 | 8.7 | 748,176 |
| 1934 | 81,600 | 26.5 | 195,200 | 63.5 | | | | | 30,900 | 10.0 | 307,700 |
| Total | 11,050,763 | 33.0 | 14,868,452 | 44.6 | 19,916 | .1 | 1,446,985 | 4.4 | 5,971,438 | 17.9 | 33,357,554 |

[1] Washington landings only.
[2] Wheel operations discontinued in Oregon some time in 1927.

## SET NETS

The set net, as used in the Columbia River salmon fisheries, consists of a section of ordinary gill-net webbing placed in a fixed location so that it intercepts the fish as they proceed on their spawning migrations. The fish must swim into the net and gill themselves in order to be captured, so some particularly favorable spot, such as the mouth of a slough or an eddy where the salmon and steelheads come close inshore, is usually selected as a site for the operation of this gear. Pieces of wornout, drift gill nets are usually used for set nets and are often made fast at one end to an old piling or snag with the other end held in place by a small anchor. In some cases an anchor is used at both ends, with a buoy on either end of the cork line to help keep it afloat. Occasionally a shallow net is provided with cedar "spreaders" which run from the cork line to the lead line and serve to keep the net extended vertically in the water.

These nets were in use to a considerable extent as early as 1880, although at that time they were confined very largely to the upper section of the fishing grounds between the Cascades and Celilo Falls. At present, however, they are common in the lower as well as the upper part of the river.

The set nets are not an important factor in the taking of the total catch of the river. From 1927 to 1934, inclusive, they took about 3.5 percent of the total catch of blueback salmon, 0.9 percent of the chinooks, 4.0 percent of the steelheads, 1.3 percent of the chums, and 0.6 percent of the silver salmon. Since 1935 the operation of set nets has been illegal in the State of Washington, so that this gear is now entirely confined to the Oregon shore.

TABLE 10.—*Salmon and steelhead catch of the set gill nets, by species, on Columbia River, 1925, and 1927 to 1934, inclusive* [1]

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1925 [2] | 5,855 | 6.1 | 42,335 | 44.1 | 11,790 | 12.3 | 8,570 | 8.9 | 27,430 | 28.6 | 95,980 |
| 1927 | 18,148 | 2.4 | 188,262 | 25.1 | 28,379 | 3.8 | 12,581 | 1.7 | 503,329 | 67.0 | 750,699 |
| 1928 | 15,992 | 3.5 | 191,023 | 42.0 | 60,292 | 13.2 | 18,790 | 4.1 | 169,076 | 37.2 | 455,173 |
| 1929 | 11,655 | 3.2 | 254,822 | 70.3 | 53,335 | 14.7 | 6,974 | 1.9 | 35,826 | 9.9 | 362,612 |
| 1930 | 16,717 | 7.2 | 126,486 | 54.9 | 4,562 | 2.0 | 4,795 | 2.1 | 77,886 | 33.8 | 230,446 |
| 1931 | 4,348 | 1.8 | 188,955 | 76.9 | 9,264 | 3.8 | 3,872 | 1.6 | 39,149 | 15.9 | 245,588 |
| 1932 | 2,484 | 3.9 | 47,168 | 73.8 | ---------- | ------ | 2,638 | 4.1 | 11,660 | 18.2 | 63,950 |
| 1933 | 39,503 | 14.3 | 168,546 | 60.9 | 19,210 | 6.9 | 16,045 | 5.8 | 33,437 | 12.1 | 276,741 |
| 1934 | 5,900 | 3.7 | 90,800 | 57.1 | 32,000 | 20.1 | 12,800 | 8.1 | 17,500 | 11.0 | 158,900 |
| Total | 120,502 | 4.5 | 1,298,307 | 49.2 | 218,832 | 8.3 | 87,065 | 3.3 | 915,293 | 34.7 | 2,640,089 |

[1] Oregon data for gill net catch, 1927–1932, inclusive, not separated into catches of drift and set gill nets. Oregon values for drift and set gill nets computed from Washington data, and corrected for differences in number of gear.

[2] Washington landings only.

## DIP NETS

This form of fishing gear was used by the Indians before the white men appeared in the Columbia Basin and, except for improvements caused by modern materials, has survived in its original form up to the present time. A dip net consists of a strong pole to which is attached an iron hoop that has woven to it a bag of small-mesh netting. The operation of a dip net is as simple as its construction. An eddy below a falls or rapids is usually selected as a site for this type of fishing, as it is such locations that the salmon and steelhead usually seek when resting before passing over such obstacles. Men using the nets place themselves so that they can plunge the net deeply into the eddy. They then sweep it downstream with the current and raise it from the water with a scooping motion. It is very seldom that they can see the fish which they are netting, and such fishing requires a considerable amount of physical labor as the net must be constantly swept through the water. In certain particularly favorable locations the nets are placed in the eddies and held stationary until a fish is felt to strike against them, whereupon they are swept up and out of the water with the fish usually safely captured. Wooden platforms for the fishermen to stand on are often constructed at favorable spots.

The area immediately below Celilo Falls is the only location on the river system where dip-net fishing of any importance is carried on. This fishery is prosecuted almost entirely by Indians, who either sell their fish to the neighboring cannery or smoke or dry them for their own use. Dip nets are also used by Indians to a small extent on some of the tributary streams.

As can be seen by consulting table 11, the dip-net catch is not a significant portion of the total catch made on the Columbia. This gear's catch, from 1927 to 1934, averaged approximately 2.0 percent of the river's total chinook catch, 4.9 percent of the blueback catch, 2.5 percent of the steelhead trout, and less than 0.5 percent of the chum and silver salmon catches. The amounts of chum and silver salmon caught by the dip nets are small because the majority of the fish of these two species spawn in tributaries below Celilo Falls and enter the river so late that most of the Indians have left the fishing grounds before the small part of the run which does reach Celilo Falls arrives there.

While it is evident that the dip nets do not account for any great part of the total catch made on the entire river, it should be remembered that their influence on the escapement into the upper river is greater than the total catch figures indicate. This situation prevails because Celilo Falls is the point farthest up the river at which any important fishing is done, and many fish leave the main Columbia to spawn in streams entering it below that point. Under these conditions only the fish whose spawning ground is in the upper portion of the river system and which have escaped through the intensive fishery in the lower river are caught by the dip nets. Therefore, the fish caught at Celilo Falls represent a much greater proportion of the run reaching that point than is suggested by the total catch figures of the entire river.

TABLE 11.—*Salmon and steelhead catch of the dip nets, by species, on Columbia River, 1889 to 1892 and 1925 to 1934, inclusive*

| Year | Blueback | | Chinook | | Chum | | Silver | | Steelhead | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds | Percent | Pounds |
| 1889 | 125,110 | 43.0 | 91,283 | 31.3 | | | 58,219 | 20.0 | 16,540 | 5.7 | 291,152 |
| 1890 | 202,325 | 33.1 | 181,602 | 29.7 | | | 102,760 | 16.9 | 124,025 | 20.3 | 610,712 |
| 1891 | 213,100 | 43.2 | 83,674 | 16.9 | | | 102,411 | 20.7 | 94,754 | 19.2 | 493,939 |
| 1892 | 372,009 | 58.3 | 48,350 | 7.6 | | | 120,653 | 18.9 | 96,702 | 15.2 | 637,714 |
| 1925 [1] | 5,307 | 14.4 | 1,886 | 5.1 | 342 | 0.9 | 2,918 | 7.9 | 26,474 | 71.7 | 36,927 |
| 1926 | 33,310 | 14.0 | 80,375 | 33.7 | | | 50 | .0 | 124,960 | 52.3 | 238,695 |
| 1927 | 1,344 | 2.5 | 32,990 | 60.4 | | | 6 | .0 | 20,232 | 37.1 | 54,572 |
| 1928 | 688 | .5 | 81,663 | 57.5 | 4,164 | 2.9 | 1,826 | 1.3 | 53,666 | 37.8 | 142,007 |
| 1929 | 6,287 | 1.6 | 302,479 | 75.2 | 8,027 | 2.0 | 2,393 | .6 | 82,845 | 20.6 | 402,031 |
| 1930 | 45,500 | 7.2 | 407,811 | 65.0 | 6,892 | 1.1 | 7,270 | 1.2 | 159,955 | 25.5 | 627,428 |
| 1931 | 24,072 | 2.9 | 708,588 | 84.1 | 31,186 | 3.7 | 7,414 | .9 | 70,747 | 8.4 | 842,007 |
| 1932 | 2,593 | 1.1 | 199,148 | 86.2 | | | 8,153 | 3.5 | 21,300 | 9.2 | 231,194 |
| 1933 | 57,644 | 6.8 | 729,105 | 85.6 | 1,248 | .1 | 8,628 | 1.0 | 54,995 | 6.5 | 851,620 |
| 1934 | 22,800 | 4.3 | 410,000 | 77.3 | 600 | .1 | | | 97,100 | 18.3 | 530,500 |
| Total | 1,112,089 | 18.5 | 3,358,954 | 56.1 | 52,459 | .9 | 422,701 | 7.1 | 1,044,295 | 17.4 | 5,990,498 |

[1] Washington landings only.

Table 11 shows that during the years from 1889 to 1934, when statistical surveys were made by the Bureau of Fisheries, the catch of dip nets was composed of 18.5 percent blueback salmon, 56.1 percent chinook salmon, 0.9 percent chum salmon, 7.1 percent silver salmon, and 17.4 percent steelhead trout. It is interesting to note that from 1889 to 1892, inclusive, the bluebacks contributed from 33 to 58 percent of the dip-net catch. The severe depletion of this species since that time is the chief reason for the decline in the importance of the blueback catch in this fishery.

Apparently dip-net fishing became less important during the period between 1880 and 1900 because many of the favorable locations were taken by men who installed fish wheels and set nets. It may be that dip netting will increase to some extent in the future, since fish wheels are now illegal on the entire river and set nets have been eliminated from the Washington shore.

## TROLL FISHERY

Two species of the Pacific salmons, the chinook and silver, can be taken readily with hook and line when a moving bait or lure is used. Apparently this fact was well known to the Indians in early times, because Suckley and Cooper (1860) describe Indians trolling for salmon in the Columbia from canoes, with smelt on single hooks for lures and small stones attached to the line as sinkers. This observation was made in about 1855. Trolling of this general type from small boats or canoes was followed by both Indians and white men at many points along the Pacific coast during all of the years of the early development of the salmon fishery. Much of it was done for profit, but many people also participated in this fishing for a recreation.

In about 1905 trolling was being carried on as a real commercial fishery at Monterey, Calif., and in Southeastern Alaska. From that time on, as the use of gasoline motors in boats became more common, it developed along the entire Pacific coast. The advent of dependable gasoline engines for fishing boats had more influence on the development and expansion of the troll fishery for salmon than any other single factor, because after that innovation it was possible for the fishermen to take their small boats out into open water and follow the schools of fish about on their feeding and spawning migrations.

The rapidity with which this fishery developed is illustrated by the events which occurred after the fishermen discovered, in 1912, that they could take chinook and silver salmon by trolling off the mouth of the Columbia. It was estimated that about 500 boats were engaged in trolling in this region in 1915, and by 1919 that number had increased to over 1,000 (Cobb, 1921). The year 1919 was apparently the peak of the troll fishery as the number of men engaged has declined since that time. According to data of the Bureau of Fisheries there were 342 trollers operating in the Columbia River district in 1926 and 155 in 1933.

Because of the fact that many trolling boats fish outside of the 3-mile limit, and are therefore not licensed, it is very difficult to obtain accurate figures on the number of boats operating. Also the trollers are quite migratory in the operations, following the salmon from one district or State to another, or fishing off British Columbia or Southeastern Alaska if it seems advisable. Therefore, the figures of total catch are more indicative of the size of the fishery than is the number of men employed in any one area.

Bureau of Fisheries statistics show that in 1926 there were 1,163,380 pounds of chinook salmon and 5,090,488 pounds of silver salmon landed in the Columbia River district, while in 1934 the landings were 534,600 pounds of chinooks and 1,871,700 pounds of silver salmon. The take of other species of salmon was negligible, since these are the only two taking a hook except in rare instances. Occasionally steelhead trout are taken in small numbers by trollers. The magnitude of the trolling operations along the Pacific coast is evident when one considers that from 1926 to 1934 the troll catch of all species of salmon and steelhead trout in California, Washington, and Oregon, had a peak of 21,042,144 pounds in 1930 and a minimum of 13,554,425 in 1933, with the annual average during that period being 16,988,398 pounds

TABLE 12.—*Troll catch of chinook and silver salmon landed on the Columbia River, by States, 1925 to 1934, inclusive*

| Year | Washington |  | Oregon |  | Total |  |
|---|---|---|---|---|---|---|
|  | Chinook | Silver | Chinook | Silver | Chinook | Silver |
|  | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| 1925 [1] | 728,249 | 1,611,633 |  |  | 728,249 | 1,611,633 |
| 1926 [1] | 393,969 | 1,482,345 | 769,411 | 3,608,143 | 1,163,380 | 5,090,488 |
| 1927 | 269,086 | 528,405 | 1,126,935 | 1,672,353 | 1,396,021 | 2,200,758 |
| 1928 | 231,819 | 591,554 | 726,789 | 1,219,932 | 958,608 | 1,811,486 |
| 1929 | 310,106 | 590,056 | 907,729 | 1,614,329 | 1,217,835 | 2,204,385 |
| 1930 | 385,302 | 1,594,381 | 624,179 | 2,886,150 | 1,009,481 | 4,480,531 |
| 1931 | 60,637 | 514,911 | 141,732 | 1,278,018 | 202,369 | 1,792,929 |
| 1932 | 21,274 | 176,984 | 188,401 | 2,578,244 | 209,675 | 2,755,228 |
| 1933 | 27,273 | 51,376 | 1,329,163 | 1,247,312 | 1,356,436 | 1,298,688 |
| 1934 | 30,200 | 103,200 | 504,400 | 1,768,500 | 534,600 | 1,871,700 |
| Total [2] | 1,729,666 | 5,633,212 | 6,318,739 | 17,872,981 | 8,048,405 | 23,506,193 |
| Average [2] | 192,185 | 625,912 | 702,082 | 1,985,887 | 894,267 | 2,611,799 |

[1] Total catch by lines.

[2] The year 1925 has been omitted.

TABLE 13.—*Poundage of troll-caught salmon and steelhead trout landed in California, Oregon, and Washington, 1925 to 1934, inclusive*

| Year | California | Oregon | Washington | Total |
|---|---|---|---|---|
|  | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| 1925 |  |  | 14,838,946 | 14,838,946 |
| 1926 [1] | 4,049,426 | 5,869,037 | 8,767,856 | 18,686,319 |
| 1927 | 4,978,472 | 4,197,455 | 9,435,064 | 18,610,991 |
| 1928 | 3,442,048 | 3,304,475 | 8,434,809 | 15,181,332 |
| 1929 | 4,043,207 | 4,728,812 | 9,212,730 | 17,984,749 |
| 1930 | 4,090,393 | 5,391,292 | 11,560,459 | 21,042,144 |
| 1931 | 3,876,692 | 2,614,922 | 11,295,142 | 17,786,756 |
| 1932 | 2,799,405 | 4,565,806 | 9,690,200 | 17,055,413 |
| 1933 | 3,677,034 | 4,072,502 | 5,804,889 | 13,554,425 |
| 1934 | 3,922,000 | 4,320,500 | 6,900,400 | 15,142,900 |
| Total | 34,878,677 | 39,064,803 | 95,940,495 | 169,883,975 |
| Average | [3] 3,875,409 | [2] 4,340,534 | [3] 9,594,050 | [4] 16,988,398 |

[1] Lines: troll and trawl not separated.

[2] 9-year average.

[3] 10-year average.

[4] 10-year average, with Washington data only for tenth year.

From 1926 to 1934, inclusive, the average annual troll catch in the Columbia River district has been 894,267 pounds of chinook salmon and 2,611,799 pounds of silver salmon. This fishery is carried on mainly in the region just off the mouth of the river, extending perhaps some 25 miles out to sea and 40 or 50 miles in either direction along the coast. Some boats operate in the estuary at the mouth of the river but rarely fish more than 10 miles up the river. However, the effect of trolling on the populations of chinook and silver salmon of the Columbia cannot be measured by the catches made in the Columbia River district alone. The silver salmon ordinarily spend 2 years of their life cycle in the ocean, while the chinooks may be in the sea from 2 to 4 years. During that phase of their existence both species are extremely migratory, going long distances from their parent stream. The Biological Board of Canada carried out a series of experiments from 1925 to 1930, inclusive, at several points off the coast of British Columbia, in the course of which they tagged and liberated troll-caught chinook salmon. After these fish were released the entire Pacific coast was canvassed for returns. Upon analyzing the returns from these experiments it was found that the percentage of total recoveries obtained from the Columbia varied from 12.5 to 60.2 percent (Pritchard, 1934). Therefore, it appears that the Columbia River contributes very materially to the troll fisheries for chinook salmon as far distant as those of British Columbia, and probably to those carried on along the entire coasts of California, Oregon, and Washington as well. Some Columbia River chinooks may also be taken by the trollers in Southeastern Alaska.

Except for the small amount of trolling done in the first few miles of the estuary of the river, trolling is not a Columbia River fishery and no detailed description of the gear and methods will be attempted here. Practically all of the fishing is done from power boats which range from Columbia River boats, remodeled so that they afford living accomodations for one or two men, to larger boats powered with Diesel engines and having a wide cruising radius and facilities for icing their catch and staying out for a week or more. The smaller boats usually come into port and deliver their catch each day. A boat ordinarily has two poles on each side, either hinged so that they can be pulled up into a vertical position or fitted into sockets so that they can be removed inboard when not in use. When the boats are fishing, these poles extend out from the side of the boat and one or two lines are attached to each pole. Additional lines are usually fished over the stern and, in some instances, lines may be fished from short poles at the bow. The lures may be any one of a variety of nickel, brass, or copper trolling spoons or spinners. Many of these lures present a combination of the colors of two of the metals mentioned. At times herring are used on a single hook and in California pilchards are also employed as bait. Lead sinkers are usually attached to the lines, their weight being varied according to the depth at which the fish are striking.

When fishing, the boats cruise slowly, towing the spoons or baited hooks through the water at depths regulated by the amount of lead used. The larger boats are usually provided with power gurdies for the purpose of pulling in the lines and fish, but many of the smaller boats are not so equipped and the fish are hauled in by hand.

## PURSE SEINES

Since purse seines are a widely used variety of gear often described in fisheries literature, and are not employed for salmon fishing in the Columbia River district at present, it does not appear advisable to give a full description of them at this time. Briefly, a salmon purse seine consists of a single curtain of webbing some 150 to 300 fathoms long and 6 to 10 fathoms deep, hung on a corkline which is provided with sufficient buoyancy to keep afloat at the surface and a lead line weighted heavily enough to straighten the net out vertically in the water. The lead line is provided with iron rings through which the purse line is run. The mesh is usually from 3½ to 4 inches, stretched measure.

When fishing is being carried on, the boat cruises until a school of salmon is located. A skiff is then put over the side with one end of the net and lines. The purse-seine vessel then encircles the school with the net as it goes. Upon completing the circle, the ends of the lines are taken aboard the seiner from the skiff and the purse line is pulled in by means of a power winch. This "purses" the net and closes the bottom so that the fish cannot sound and swim under it. The net is then hauled in and piled on the turntable located on the stern of the boat. A power roller on the turntable is used on most boats to facilitate this operation. As the net is hauled in the fish are confined in a progressively smaller space until they are brought alongside in the bunt of the net from which they are brailed into the hold.

This type of fishing was first carried on in Puget Sound at an early date, probably before 1890, by means of small boats which were, of course, without power. After engines became available for small boats, this type of fishing advanced rapidly. The boats are now powered with gasoline or Diesel engines and vary from 40 to 80 feet in length.

Purse seining made its appearance on the Columbia in 1905, when Mr. William Graham, of Ilwaco, Wash., began to operate this type of gear. In 1906, 4 or 5 additional purse seines were in use and this activity continued until 1911, which was apparently the last year of that early period of purse seining. These men did not have regular purse-seine boats, but pulled their seines, which were from 200 to 250 fathoms long, from scows. The fishing grounds were in the extreme lower portion of the river, from the lower end of Sand Island to Point Ellice. The fishing was done only during the slack portions of the tides and some 8 or 9 sets were made daily. In 1911 they landed as much as 3½ tons of salmon per boat daily.

The next appearance of the purse seines in connection with the Columbia River was in 1917, when seine boats from the Puget Sound fisheries made their appearance. Washington and Oregon both made it unlawful to fish with purse seines in the Columbia in 1917, so that this fishing was limited to the area outside of the river mouth. Most of the fishing was done in the shoal water just north of the north jetty, which is at the entrance to the river. In 1922 it became unlawful to fish or possess a purse seine in any of the waters of the State of Oregon. Washington made it illegal to use purse seines in any of its outside coastal waters in that same year, and since all of the fishing in the vicinity of the Columbia was done close inshore, these two legislative acts marked the end of the purse-seine fishing in the Columbia River region.

Table 14 shows the number of salmon and steelhead trout landed by purse seines on the Washington side of the river from 1917 to 1921, inclusive. Unfortunately no figures are available for the Oregon deliveries. The landings varied from about 11,500 to approximately 77,000 chinook salmon, and from less than 200 to about 24,000 silver salmon annually, in addition to which there were significant amounts of blueback salmon and steelhead trout taken (Washington (State) Forty-second to Forty-fifth Annual Reports, 1936.)

TABLE 14.—*Number of salmon and steelheads caught by purse seines in the Columbia River district of Washington, by species, 1917 to 1921, inclusive* [1]

| Year | Chinook | Chum | Pink | Silver | Blueback | Steelhead | Total |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Number* | *Number* | *Number* | *Number* | *Number* |
| 1917 | 11,583 | 246 | 34,634 | 3,608 | 9,484 | 677 | 60,232 |
| 1918 | 43,278 | | 385 | 24,318 | 157 | 3,480 | 71,648 |
| 1919 | 76,819 | | | 16,290 | 333 | 1,161 | 94,603 |
| 1920 | 39,623 | 1,127 | | 4,045 | 26 | 1,725 | 46,546 |
| 1921 | 15,653 | | 835 | 178 | 790 | 332 | 17,788 |
| Average | 37,393 | 275 | 7,171 | 9,688 | 2,164 | 1,475 | 58,155 |

[1] Data from Forty-second to Forty-fifth, inclusive, Annual Reports of the State Department of Fisheries, State of Washington, B. M. Brennan, Director of Fisheries, Olympia.

Because of the fact that this fishing was carried on immediately adjacent to the entrance to the Columbia, it is probable that the greater part of the fish caught were Columbia River salmon, and since it was of considerable importance while it existed, purse seining was a significant factor in limiting the spawning escapement into the Columbia for the brief period of time from 1917 to 1921.

## BOATS

Boats are usually one of the most important and costly pieces of equipment used in the capture of any species of fish, and the fisheries of the Columbia River do not present an exception to this statement. Powerboats and skiffs are used in operating the haul seines, boats are used in taking the fish from the traps or pound nets, and the

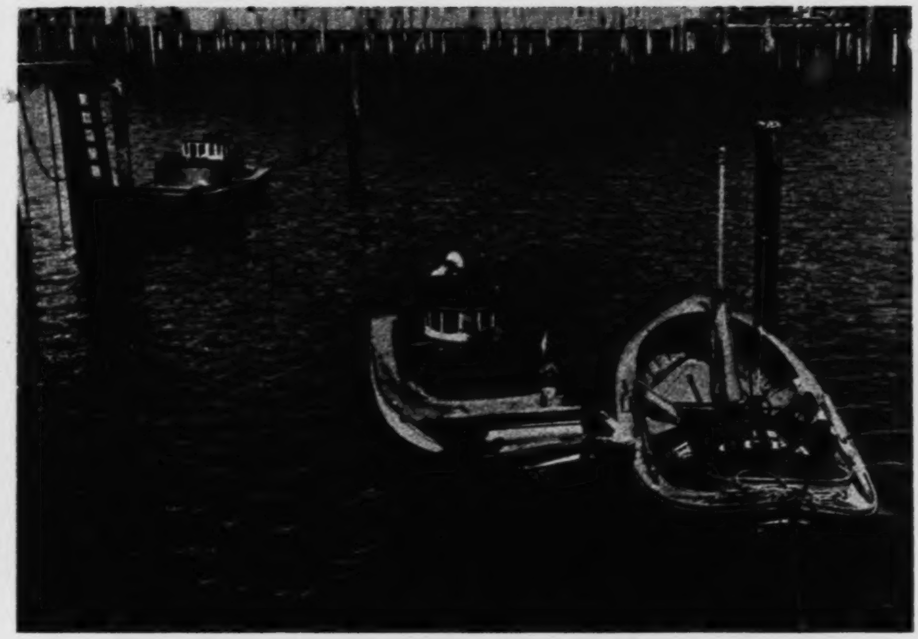

FIGURE 12.—Typical Columbia River gill-net boats.

FIGURE 13.—Type of launch used in transporting salmon from buying stations to canneries.

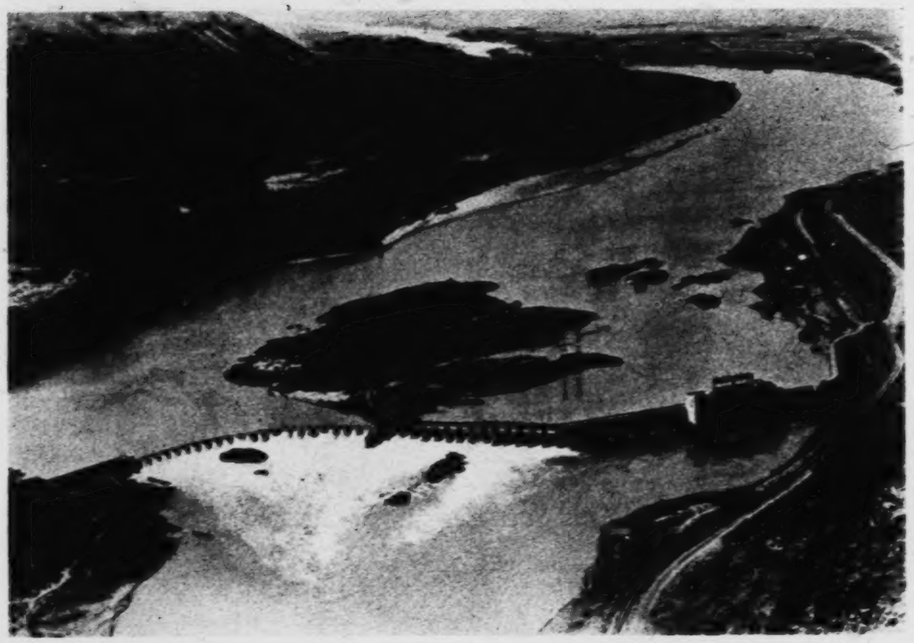

FIGURE 14.—Rock Island Power Dam, near Wenatchee, Wash.

FIGURE 15.—Unscreened irrigation diversion in a spawning area.

important gill-net operations are carried on with a boat in conjunction with each net fished. In addition to these craft directly employed in the capture of fish, there are many boats used in transporting fish from the buying stations and fishing grounds to the canneries.

### GILL-NET BOATS

The boats used in the gill-net fishing are the most numerous of any of the various types on the river. As can be seen by referring to table 15, there were 2 of these craft in 1866, the year when the canning industry had its beginning. This number increased rapidly until there were 1,700 in 1883. The incomplete records which are available indicate that from 1888 to 1934 they fluctuated in number between a minimum of 1,226 in 1889 and a maximum of 2,596 in 1904.

TABLE 15.—*Number of gill-net boats on the Columbia River, 1866 to 1934* [1]

| Year | Number of boats [2] | Year | Number of boats [2] | Year | Number of boats [2] | Year | Number of boats [2] | Year | Number of boats [2] | Year | Number of boats [2] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1866 | 2 | 1873 | 125 | 1880 | 900 | 1890 | 1,244 | 1909 | [4] 2,348 | 1929 | 1,741 |
| 1867 | 15 | 1874 | 250 | 1881 | 1,200 | 1891 | 1,410 | 1923 | 1,604 | 1930 | 1,608 |
| 1868 | 25 | 1875 | 300 | 1882 | 1,500 | 1892 | 1,536 | 1925 | 1,605 | 1931 | 1,495 |
| 1869 | 35 | 1876 | 400 | 1883 | 1,700 | 1894 | 2,200 | 1926 | 1,790 | 1932 | 1,307 |
| 1870 | 50 | 1877 | 450 | 1888 | 1,435 | 1895 | 2,207 | 1927 | 1,885 | 1933 | 1,253 |
| 1871 | 75 | 1878 | 550 | 1889 | 1,226 | 1904 | [3] 2,596 | 1928 | 1,589 | 1934 | 1,359 |
| 1872 | 100 | 1879 | 750 | | | | | | | | |

---

[1] Data for the years 1866-83 and 1888, from Collins (1892); 1889-91, Wilcox (1895); 1894-95, Wilcox (1898); 1904, Wilcox (1907); 1909, Cobb (1911); 1923, 1925, 1926, Sette (1926, 1928, 1929); 1927-34, Fiedler (1930-36).

[2] For later years the number of boats is the total of those operating drift gill nets and set gill nets.

[3] Of this number only 43 were powerboats; the remainder were sailboats and rowboats.

[4] Of this number 425 were powerboats; the remainder were sailboats and rowboats.

Many of the first boats used in the gill-net fishery were Whitehall boats and skiffs. but these gave way rapidly to the now common Columbia River style of fishing boat, Since these Columbia River gill-net boats gave rise to a distinct type of fishing boat which came into general use in the fisheries of the Pacific coast from Alaska to southern California, and which is still called a Columbia River boat, a brief description of their development and type of construction is presented. The exact date and circumstances surrounding the appearance of these boats on the Columbia are not definitely known. Collins (1892) states that Mr. J. J. Griffin, of San Francisco, built a fishing boat for a Sacramento River salmon fisherman in 1868 and in the next year one of the same type for George and Robert Hume, operators of the first salmon cannery on the Columbia, for use on the Columbia River. He further states that these boats were the type which later became the well-known and widely used Columbia River boats.

However, Robert Hume, in the Pacific Fisherman (vol. 6, No. 1), stated that in 1872 he operated for the first time three boats built by Mr. Collins, of San Francisco, which were of the type later to become known as the popular Columbia River fishing boat. In any event it is evident that this style of boat appeared at a very early date in the development of the salmon fisheries of the Columbia and that its efficient design has enabled it to persist in the fisheries of the entire Pacific coast up to the present time.

At first the boats were from 22 to 23 feet in length and were usually entirely open. In 1872 the boats were undecked, but by 1880 washboards had been added, with small deck spaces at the ends. In the eighties the majority of the boats were 24 feet in length, although boats 25 to 26 feet long had been tried but were thought to be too unwieldy for two men to manage.

Boats built in Astoria, Oreg., cost from $200 to $250 in the late seventies and early eighties, while those built in San Francisco were more expensive, costing as much as $350. In the late eighties the boats ranged in size from 23 to 28 feet in length, 6 to 8 feet in width, and from 24 to 30 inches in depth, and cost, when rigged for use, from $300 to $400.

Many of the early boats were constructed in San Francisco, but this work was gradually taken over by Columbia River boatshops. In some cases the boats were constructed at cannery shops and, with few exceptions, the boats were owned by the canners and rented to the fishermen. A few of the early boat builders on the Columbia River were S. B. and J. F. Barrows, who had a shop on the Lewis and Clark River—a tributary of the Columbia below Astoria, Oreg.; H. Farnsworth, whose shop was in Uppertown—now part of Astoria; and Richard Leathers, whose shop was in Astoria. Mr. Leathers is credited with refining the lines of the Columbia River gill-net boats in the course of his operations.

Collins (1892) has given a description of the Columbia River gill-net boat of that time.

> It is an open, carvel-built, center-board craft, sharp forward and aft, the ends being shaped nearly alike, moderately concave at and below the water line, and with rather full convex lines above the water. It has a long, low floor, round bilge, and flares slightly at the top. It has a very shallow keel, and has little or no rake to the stem or stern post, both of which are straight, with the exception of the rounded fore foot. It is decked for 2 or 3 feet at each end, and has washboards extending along both sides. A coaming 2 or 3 inches high runs around on the inner edge of the washboards and the decked spaces of the bow and stern, making the open part of the boat of an oval form. It has four thwarts, and there are three rowlocks (each with a single thole-pin) on each side. A single mast, upon which is set a spritsail, is stepped well forward. Oars are carried and used when there is no wind. The dimensions of this boat, which is a trifle larger than the average, are as follows:

| | | |
|---|---|---|
| Length over all | feet | 25¾ |
| Beam | do | 6¾ |
| Depth | do | 2 |
| Height amidships, gunwale to bottom of keel | do | 2½ |
| Height at ends | do | 3 |
| Length of mast | do | 16¼ |
| Length of oars | do | 12 |
| Cost, ready for use | | $400 |
| Number of men in crew | | 2 |

> Ordinarily a salmon boat has a single spritsail, the mast stepping in the forward thwart and being adjustable so that it can be removed at will. Occasionally a jib is carried. On the Sacramento and San Joaquin Rivers a single leg-of-mutton-sail rig is in favor. Spritsails are also used. In strong winds the latter is reefed by taking out the sprit and fastening the peak to the mast. Often when the men are engaged in drift fishing they are compelled to remain away from home for more than a day. Under such circumstances it is common for them, after the nets are hauled, to anchor their boats near the shore or bars of the rivers, out of the way of passing steamers. They then rig up a temporary tent of the sail, using the mast for a ridgepole to spread the canvas over, the after end of the mast resting upon the rudder, which is put up for a support. The men thus lie down for sleep, and this is as frequently done in the daytime as at night, since it often happens that the men are out all night drifting with their nets. Each boat is provided with a small oil stove and an assortment of canned food, which is warmed up, and the meals are thus prepared on board. This applies more particularly to the Columbia River.

The most important improvement in the boats of the gill-net fleet took place when gasoline engines were installed. It should be remembered that a gill net is fished by drifting the extended net down a clear section of the river. The net must be picked up when the end of the drift is reached and a trip made to the head of the same or another drift before the net can be laid out and fished again. Powerboats could return to the starting point of the drifts much more rapidly than boats which depended on sails and oars to overcome the currents and tides. Also the powerboats could maneuver more quickly and satisfactorily in handling the nets. Therefore, the addition of gasoline engines to the fishing fleet of the Columbia greatly improved its efficiency and increased the catch per boat per day considerably.

The date of the installation of the first gasoline engines in Columbia River boats is not clear. However, in "Salmon of the Pacific Coast" by R. D. Hume, published in 1893, there appeared an advertisement which stated that the Union Gas Engine Co., of San Francisco, had supplied several packing companies and fishermen on the Columbia River with engines suitable for fishing boats and other small craft. In 1897 F. J. Larkins, a machinst of San Francisco, equipped some of the local fishing boats with his 1¼-horsepower gasoline engines, the entire cost of engine and installation being $92. The engine was placed snug to and abaft the fishbox amidships. It is known that within the next year he wished to equip the Columbia River boats with his engines. However, powerboats did not become common on the Columbia until several years later.

Gasoline boats were universally used by the fishermen of California by 1904, but their use on the Columbia was somewhat delayed, since the fishermen there were of the opinion that they prevented the salmon from entering the nets. In 1904 there were only 43 powerboats in use on the Columbia, as against 2,553 rowboats and sailboats. This number of powerboats had increased to 425 in 1909, and there were 1,923 sailboats and rowboats in that year (Wilcox, 1907, and Cobb, 1911). In 1915 all were gasoline boats and the fleet was completely motorized (Radcliffe, 1919).

The first departure from the standard Columbia River type in boat construction began to take place in the gill-net fishery very shortly after 1920. This change was marked by the appearance of the so-called one-man boats which are now quite common on the river. It was not until 1928, however, that more new one-man boats were built than new two-man boats. Approximately two-thirds of the gill-net boats on the river now are of the one-man type. The change from the two-man gill-net boats to the one-man type was purely an economic move, brought about by the fact that in most parts of the Columbia River one man, with a boat of proper design, could take almost as large a catch as could two men working a two-man boat operating in the same waters.

These newer one-man boats are from 25 to 27 feet long, have a 7- to 8-foot beam and are from 27 to 36 inches deep, with transom sterns. Engines up to 50 horsepower are used, but motors from 3 to 10 horsepower are more common. The lines have been refined to provide greater efficiency with the motors and reduce the labor of handling. The engines and cabins are set far aft. These boats carry a thwartship roller extending across the full width of the boat just forward of the house and the net pays out over this roller as the boat is driven ahead under power. Tiller lines and clutch extensions are carried forward, enabling the fishermen to work in the bow, picking up their nets, and at the same time to control the boats. Many of them are equipped with power net-pullers.

Although designed primarily for fishing in the quieter portion of the river, one-man boats may be adapted to rougher water by raising their freeboard and giving the bows a greater flare. These boats, when fishing at the mouth of the river, usually carry two men because of the severe weather and tide conditions which often prevail in that area.

The one-man boats are commonly called "bow pickers" because the net is carried in and fished from the bow instead of in the stern, as in the case with the two-man boat. Either diver or floater nets can be used effectively with this boat.

*Power net pullers.*—After a drift gill net has been laid out and allowed to float to a point where it is necessary to discontinue fishing, it must be hauled aboard the boat and piled, in preparation for laying out when the next drift is started. The task of pulling in a long gill net and piling it requires considerable labor when done by hand and was one of the chief reasons for gill-netters having two men on each boat, until recent years. Power net pullers are mechanical devices designed to perform most of the labor necessary in hauling in the nets. They are round drums which are revolved by power supplied by the boat's engines, over which the nets run from the water into the boat, there being sufficient friction between the nets and the rollers to cause the nets to be pulled in. Their use permits one or two more drifts per tide than could be made if the nets were picked up by hand. The development of these machines has progressed along with the increase of one-man boats and their number has grown until most of the newer boats are equipped with them at the present time.

These devices are of two types; namely, the single gypsy, and the horizontal power roller with idling guide rollers. In addition to these there is an unpowered horizontal roller with vertical guide rollers. None of the gypsy type were observed in 1935. Presumably it was harder to work than the horizontal roller type and so fell into disuse. The gypsy was either set upright in the bow or projected horizontally over the washboard on either side. The net was taken around the gypsy in a full turn, the slack being taken away by hand and piled. A few of them had clutches to facilitate their operation. The gypsy head was made of bronze, steel, or wood and varied from 5 to 12 inches in diameter and 10 to 20 inches in height.

The horizontal power roller is made up of three rollers, the power-driven roller and vertical idling rollers at each end. All three rollers are set in the same bronze or steel frame with approximate over-all dimensions of 18 inches high by 20 inches wide. The horizontal drum is generally of iron, although a hardwood drum on a steel shaft is sometimes used. When the drum is of cast iron it is perforated to permit additional gripping material, such as strips of automobile tire, to be wired on. This drum is usually about 18 inches long, by 12 or 14 inches in diameter, and the newer ones are made concave in order to increase the grip of the roller on the net. The idlers are about 16 inches long, and are tapered from about 3½ inches diameter at the top to 2 inches at the bottom. This tapering helps prevent any slack webbing from climbing the sides of the roller and becoming fouled. The idlers are set about 15 inches apart.

The horizontal power roller type is fastened to the washboard or coaming at the bow of the boat, and is built to extend outboard. Fastenings and power connections are made so the whole device may be swung inboard when not in use. Power is supplied from the main engine by a long shaft, driving the rollers by means of gears, or a chain and sprocket. A clutch is usually provided, to permit the fishermen to stop the roller to take out fish or trash, or to clear fouls.

In operation, the boat is kept moving slowly ahead, so as to bear slightly against the net and so give the roller a better grip on it. From 30 to 50 percent of the circumference of the roller is in contact with the net. This type of power roller is particularly adapted to picking up the narrow diver nets, the web of which comes up in a compact rope.

On September 14 and 16, 1935, 297 boats were observed at Astoria, Oreg. One hundred and ninety (64 percent) of these were one-man boats. Of these 190 boats, 77 (40.5 percent) had power rollers, 47 (24.7 percent) had the plain unpowered rollers, and 66 (34.7 percent) had no visible place for setting on a roller. Of the 107 two-man boats only 5 (4.7 percent) had rollers, and these were of the unpowered type.

### FISH LAUNCHES

Because of the fact that the salmon fishery is carried on along some 200 miles of the Columbia, from the river's mouth to Celilo Falls, it is not possible for the fishermen to make daily deliveries of their catches to the canneries. Therefore, the cannery operators have established buying stations at many conveniently located points on the fishing grounds where the fishermen deliver their daily catches. Boats, commonly called fish launches, are used to transport the fish from the buying stations to the canneries. At the present time these launches average about 17 tons gross (11 tons net) and are about 52 feet in length. Their engines, either gasoline or Diesel, are usually about 50 horsepower. They are the tender or work-boat type of craft, usually with an open deck, a boom, and power equipment for hoisting the fish aboard. The fish are ordinarily carried as a deck load in boxes and it is only when a capacity load is transported that any of the fish are put in the hold. Some of the larger boats are used to pick up troll-caught fish from the coastal receiving stations as well as operating in the river. In the very early days of the industry sailboats of various description, and later steam tugs and launches, were used for this purpose. The steamboats had a slightly higher average tonnage than the boats used at the present time.

### SEINE LAUNCHES AND SKIFFS

Two boats are used in operating each large haul seine on the Columbia. The seine is piled in a large skiff which is towed by the seine launch as the net is laid out. As soon as the line at the head end of the seine is returned to shore the launch casts loose from the skiff and the skiff is held in on the beach while the seine is repiled. On some of the larger seining grounds two seines and skiffs are employed and, as soon as the first seine has been hauled onto the beach, the launch goes back and starts a second haul with the other skiff and seine. Therefore, the practice of laying out the seines from skiffs, rather than directly from power launches, is of advantage not only on shallow beaches where the launches would have difficulty in getting close to the shore but also permits the alternate operation of two seines on the same grounds with only one power boat.

The seine skiffs average about 30 feet in length with a beam of about 11 feet. They have a pointed bow, a broad square stern, and are propelled with oars when not in a position to be towed by the seine launch.

The launches are of the work-boat type, with a flush deck and small cabin. Their lengths range from about 27 to 43 feet, with an average beam of about 9 feet. They are powered with either gasoline or Diesel engines which may have a horsepower of from 12 to 100, with an average of about 42.

## FACTORS INFLUENCING SALMON PRODUCTION

In the preceding pages the development of the salmon-fishing industry of the Columbia, from the crude activities of the original Indian inhabitants through the early attempts of the pioneers and the modern achievement of a great industry worth millions of dollars and employing thousands of people, has been described. It has been pointed out that the offspring of salmon which spawn in the Columbia are caught in the sea along the Pacific coast from Southeastern Alaska to northern California, that the mature fish are subjected to an intense fishery when making their spawning migrations through the first 200 miles of the river channel, and that this fishery annually takes many thousands of these potential spawners, allowing only a portion to escape for the purpose of perpetuating the population of Columbia River salmon. At first glance it appears that all that is necessary for the continued maintenance of these fisheries is proper regulation of the fishing so that sufficient spawners escape to the upper tributaries each year to produce offspring numerous enough to provide adequate catches and spawning escapements for the future. Unfortunately this is not the case.

The importance of proper fisheries regulations and adequate spawning escapements cannot be overemphasized, and certainly the disastrous effects of depletion caused by overfishing are well known. It is also evident that unless an adequate broodstock is maintained in any fishery the industry will not be able to continue at a normal level of production. But, in considering problems of conservation connected with anadromous fishes in general, and the salmon and steelhead trout in particular, a second important question—that of maintenance of suitable spawning and nursery grounds—arises. No matter how large an escapement of anadromous fishes may be allowed, the returns from that escapement will not be satisfactory unless the spawners have free access to spawning grounds adequate in size and suitable for the deposition and development of their eggs, and to streams which provide proper food, chemical, and temperature conditions for the young fish, and down which those young fish can migrate safely to the sea without the hazards of diversions or obstructions.

The species which enter into the catches of the commercial fisheries of the Columbia are the chinook salmon, silver salmon, blueback salmon, chum salmon, and steelhead trout. Upon reaching maturity the chinook salmon enter the river from the sea and seek some tributary or upper portion of the main river providing gravel suitable for the deposition of their eggs. After the eggs are deposited, natural conditions must be satisfactory for the eggs and young fish to survive. The eggs hatch in the late winter or spring following the fall in which they were deposited. The young fish then live in the tributaries for lengths of time varying from a few weeks to 3 years, after which they make their way into the ocean.

When returning from the sea to spawn, the chinook salmon enter the particular tributary in which they were hatched or reared and ascend to the spawning grounds, with only a few straying. Their urge to ascend those particular streams is so strong that if for any reason they are closed to them the salmon show little if any disposition to retrace their paths and enter other streams. Except in extremely rare instances the Pacific salmon do not feed after entering fresh water to spawn, and all die after completing their reproductive functions. Because of their habit of returning to their parent stream the chinook salmon inhabiting each tributary of a large river system, such as the Columbia, form a separate population unit from the fish of the same species inhabiting other tributaries. Each of these units has developed individual characteristics, such as a certain energy content, upon which the fish must depend from the time they enter fresh water until they spawn and die, since they do not feed during that period. The time of migration and spawning, and other habits which make them particularly suited to their home stream, are also developed with some degree of uniformity by the individuals of each population.

The blueback salmon of the Columbia, called sockeye on Puget Sound and red salmon in Alaska, have much the same habits as the chinooks. They usually remain in fresh water until their second year and have the same marked homing instinct as the chinooks. They differ from the other species, however, in that they almost always spawn in a stream above a lake. The young fish, after hatching, descend into the lake and spend their juvenile fresh-water existence in that environment. The silver salmon also closely resemble the chinooks in their life cycle except that nearly all of them entering the Columbia are 3 years old when mature, instead of 3 to 6 years old as are the chinooks. Chum salmon enter short streams or lower tributaries to spawn and the young apparently spend little or no time in fresh water before starting their seaward migration. Otherwise, their habits are much the same as the chinooks. The steelhead trout behave like the chinooks in most respects, spending from 1 to 3 years in the fresh water after hatching. What little information is available indicates that they have a homing instinct comparable to the salmon. However, they feed after entering the streams to spawn and they do not all die after spawning.

From the foregoing it is evident that the salmon and steelheads must have free access to their spawning grounds. A blocked spawning tributary means the loss of the race of fish using that stream unless some steps are taken to salvage them, because they will not go elsewhere to spawn. The spawning gravels must be kept free from silt or other deposits which smother the eggs. Food must be present in the stream for the young fish, and proper temperatûres for the development of the eggs and the growth and survival of the young fish must prevail. The streams must be free from injurious chemicals, sewage, and other pollutions, and the young fish must have unobstructed passage down the streams and into the ocean in order to complete that important part of their life cycle in which most of their growth is made. The streams are roads of communication between two vitally essential parts of the habitat of anadromous fishes, as well as constituting one of those parts. Therefore, if the salmon and steelheads are to persist in significant numbers, the streams must be maintained in something approaching their natural conditions and with open pathways for the fish to and from the ocean.

The great abundance of salmon and steelheads in the Columbia before the settlement of its basin is evidence that it originally provided a very suitable habitat for those fish. However, conditions have been greatly changed within the last hundred years and these changes have been brought about by the activities of the men who have settled and developed this vast area and utilized its natural resources. Agriculture demands water for irrigation, which requires dams across streams with part of the stream diverted into ditches so that the flow in streams is greatly diminished and in some cases entirely eliminated. The dams often present impassable barriers to the fish unless adequate fishways are installed, and if the diversion intakes are unscreened the young downstream migrants enter them and are lost. Mining operations also often necessitate the diversion of water from natural stream channels and at times tailings and chemicals used in refining ore are allowed to escape into streams with disastrous results to the fish and other forms of aquatic life.

The lumbering industry cuts over large areas of forests, sometimes resulting in a destruction of the natural forest cover. This often has a widespread and fundamental effect on the streams draining such an area. The elimination of trees and shrubs adjacent to a stream may seriously curtail the number of the insects which are used for food by the young fish and may also cause the temperature of small tributaries to be higher than normal because of the lack of shade. Absence of forest cover also results in a rapid run-off, which scours streambeds in times of freshet, leaving them poor in fish food and perhaps with the spawning gravels covered with silt or moved about so that fish eggs which have been deposited are destroyed. Also those rapid run-offs may bring about a condition of very low water or even a complete drying up of streams during dry seasons. In many instances logging activities make necessary the construction of dams and the diversion of water from the stream. Pulp mills are often sources of pollution because of the discharge of their waste products into the streams. The development of hydroelectric power means the construction of dams across streams and the diversion of part of the flow through power plants and turbines. With some types of turbines the mortality of young fish passing through them is extremely high. The presence of a large population of human beings materially influences conditions in the streams draining the watershed in which they reside. Domestic and industrial wastes of all kinds usually find their way into streams, with pollution detrimental to fish life resulting. Large numbers of people in the neighborhood of spawning tributaries results in the capture of adult spawners and young fish, and many of their activities bring about elimination of forest cover either through fires or the clearing of land.

Since the utilization of natural resources and the general development of a region have a profound effect on a fishery which depends upon anadromous species using streams draining that area for spawning purposes, a brief mention of these activities in the Columbia Basin is pertinent to the problem being considered. This discussion must necessarily be brief, but it is hoped that it will serve as a part of the background for the consideration of the problems of fishery conservation on the Columbia.

## POPULATION

The first permanent settlers moved into the basin of the Columbia River soon after its discovery in 1792. Commerce in furs was the chief industry of the region until almost 1850, and Vancouver, Oregon Territory, was the chief center of business. McLoughlin, of the Hudson's Bay Co., urged the older employees of that organization to settle in the Willamette Valley when they wished to retire, and by 1835 there were a number of such families located there. The two American missionaries, Jason and Daniel Lee, established Methodist missions in the Willamette Valley in 1834 and, in 1837, 20 more missionaries arrived and another mission was established where The Dalles, Oreg., is now located. In 1840, 50 more Americans arrived by sea and by that time the American population in the Oregon country numbered 151. Other early immigrants were attracted to the region by its mineral resources. Mining continued to be an important factor in the growth of the population of Idaho and Montana into the second decade of the present century.

The permanent settlement of the region for agricultural purposes received its first real impetus in 1842 when Dr. Elijah White guided the first immigrant train over the Oregon Trail. This party consisted of about 100 individuals. After this the number of new arrivals in the Oregon country increased rapidly, and nearly 1,000 men, women, and children followed the trail in 1843 and settled in the Willamette Valley. These people were followed by about 1,400 in 1844 and 3,000 in 1845.

Some of these first settlers left the region in the period from 1848 to 1850 for California when gold was discovered there. But this was more than compensated for when another influx of immigrants resulted from the "Donation Land Act" which was passed by Congress in 1850 and which gave settlers large tracts of land free of charge. The discovery of gold in Idaho and eastern Oregon also assisted in the settlement of those areas. Mining operations helped to furnish a market for agricultural products and this factor, together with the development of cattle raising in eastern Washington and Oregon, and in Idaho, and the development of the farming areas in the valleys, formed the basis of the increase in population until late in the sixties. By 1870 there were about 130,000 people in what are now the States of Washington, Oregon, and Idaho. At that time Walla Walla was the largest city in Washington and it was not until 1880 that Seattle had a larger population. Because of the early development of the Willamette Valley, Oregon had twice the population of Washington and over five times that of Idaho during these early years. Between 1880 and 1890 the construction of transcontinental railroads was a very important factor in encouraging new settlers to seek the Northwest.

Increase in population growth between 1890 and 1900 was somewhat retarded by the panic of 1893, but this was more than equalized by the influx of new people caused by the discovery of gold in Alaska and silver in Idaho. Also, irrigation opened up new lands to farming in eastern Washington and Oregon, and in Idaho at that time. The increase in population between 1890 and 1900 was about 43 percent and during the decade from 1900 to 1910 the increase was extremely rapid, amounting to about 90 percent. The utilization of the timber resources had a very vital part in this expansion. Since that time, as the exploitation of the resources has maintained a fairly even level, the increase in population has been considerably less.

## LUMBERING

The first lumbering operations in the Columbia Basin were undertaken in 1835 when the Hudson's Bay Co. began to ship sawn lumber and spars from their Columbia River posts to the Hawaiian Islands. This lumber came from two mills which were located near Fort Vancouver. The withdrawal of the Hudson's Bay Co. from the area in the late forties put an end to this commerce, but soon after 1850 lumbering began to be carried on for the local market to a small extent. However, it was not until late in that century that it began to develop into a large industry. There were two chief reasons for the rapid expansion in lumbering which occurred between 1890 and 1900. These were the reduced rates on lumber from the Northwest to Middle Western markets, given in 1893 by the transcontinental rail lines in an effort on their part to build up their east-bound traffic, and the fact that in that same decade the depletion of the timber of the Great Lakes States had reached such a point that capital and labor moved from that area to the practically virgin forests of the Northwest.

In 1855 there were 16 sawmills in the Northwest, with a daily combined capacity of 85,000 board feet. By 1857 the number of mills had increased to 37 in what is now the State of Washington, and, by 1880, 256 mills, with an annual capacity of 500,000,000 board feet, were operating in Washington and Oregon. The number of mills continued to increase until Oregon and Washington each possessed 569 mills in 1929. Washington ranked sixth among the States in lumber production in 1899 and was in second place in 1904. By 1905 it reached first position and has held that leadership up to the present time except for 1914, when the production of Louisiana was slightly greater.

Almost all of the lumber produced in the Pacific Northwest consists of softwoods. Douglas fir is the most important species cut, with hemlock, ponderosa pine, white pine, spruce, and birch varying in importance in different localities. The four Columbia Basin States, Washington, Oregon, Idaho, and Montana, have forest lands which contain more than half of the remaining timber supply of the United States, and which at the present time supply 36 percent of the Nation's lumber. This area in 1935 had 917 billion board feet of merchantable lumber, covering 93,000,000 acres, as against a total of 1,668 billion board feet for the entire country.

## MINING

Because of the fact that detailed data are not available for mining development and production in the Columbia Basin, it is not possible to give a complete discussion of the development of those resources in the region. The exploitation of the mineral resources began with gold mining in 1860 and 1870 and contributed materially to the development of the region in those early days. The two most important mining sections in the Pacific Northwest are those near Butte, Mont., and the Coeur d'Alene region in Idaho. Neither of these influence the migratory fish of the Columbia, since Clarks Fork, which drains the country surrounding Coeur d'Alene and Butte, is ascended by few if any anadromous fish.

However, there are many widely scattered mining operations in the Columbia Basin which produce metallics consisting of gold, silver, copper, lead, and zinc, and nonmetallics embracing a wide field of products such as petroleum, coal, building stone, clay, feldspar, limestone, sand, and gravel. The metallics are the most important in this region, and are produced in approximately the following proportions of the Nation's output of metals: 7 percent of gold, 15 percent of copper, 27 percent of lead, 35 percent of silver, 20 percent of mercury, and 7 percent of zinc. Table 16 shows the national rank of the four Pacific Northwest States in mineral production and the percent of the total value for the United States which they contribute:

TABLE 16.—*States and their principal mineral products in 1933* [1]

| State | National rank | Percent of total value for United States | Principal mineral products in order of value |
|---|---|---|---|
| Washington | 31 | 0.40 | Coal, cement, stone, sand and gravel. |
| Oregon | 39 | .15 | Stone, sand and gravel, cement, gold. |
| Idaho | 30 | .53 | Lead, silver, zinc, gold. |
| Montana | 22 | .93 | Natural gas, copper, coal, petroleum. |

[1] Data from Statistical Appendix to Minerals Yearbook, 1934.

## HYDROELECTRIC POWER

In general, the early development of hydroelectric power in the Pacific Northwest, and the Columbia Basin, closely paralleled the advances made in methods for generating, transmitting, and using the power. Prior to 1900 most of the power was used to operate arc lights, which required high voltages, making it both dangerous and difficult to adapt the power to other purposes. Incandescent lighting was introduced in about 1900, with low voltage and circuits operated in parallel. This current could be safely introduced anywhere and put to uses other than lighting. As a result the use of electric motors increased with great rapidity, so that the supply of power current constituted an important part of the central-station business. Also, the first two decades of the present century witnessed important technical advances in water-power utilization, with the result that by 1914 the efficiency of hydro turbines had increased from 10 to 15 percent and improvements in hydraulic and electric machinery had brought about a greater use of the available power. Then the introduction of high-tension transmission enabled power to be carried for long distances and permitted the establishment of hydroelectric plants at considerable distances from the points of consumption.

TABLE 17.—*Hydroelectric power production in the Pacific Northwest* [1]

| Year and State | Number of water wheels and turbines | Horsepower of prime mover | Generator capacity in kilowatts |
|---|---|---|---|
| **1902** | | | |
| Washington | 41 | 17,238 | |
| Oregon | 44 | 11,118 | |
| Idaho | 23 | 3,924 | |
| Montana | 44 | 24,000 | |
| Total | 152 | 56,280 | |
| **1907** | | | |
| Washington | 48 | 56,118 | |
| Oregon | 72 | 102,052 | |
| Idaho | 37 | 11,492 | |
| Montana | 62 | 56,987 | |
| Total | 219 | 226,649 | |
| **1912** | | | |
| Washington | 64 | 77,591 | |
| Oregon | 60 | 29,802 | |
| Idaho | 63 | 51,580 | |
| Montana | 64 | 102,885 | |
| Total | 251 | 261,858 | |
| **1917** | | | |
| Washington | 70 | 114,168 | |
| Oregon | 80 | 41,066 | |
| Idaho | 71 | 53,624 | |
| Montana | 78 | 268,917 | |
| Total | 299 | 477,775 | |
| **1927** | | | |
| Washington | | 698,729 | 503,247 |
| Oregon | | 169,216 | 118,452 |
| Idaho | | 302,839 | 204,487 |
| Montana | | 363,503 | 258,751 |
| Total | | 1,534,287 | 1,084,937 |
| **1932** | | | |
| Washington | 125 | 925,554 | 655,679 |
| Oregon | 92 | 277,201 | 193,031 |
| Idaho | 91 | 303,337 | 205,085 |
| Montana | 71 | 423,943 | 298,960 |
| Total | 379 | 1,930,035 | 1,352,755 |

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[1] Data from census of electrical industries.

The development of hydroelectric power began at an early date in the Columbia Basin. In 1885 a franchise was granted to a Mr. Fitch to furnish electric service to the town of Spokane Falls. A brush-arc dynamo of 4 kw. capacity, capable of operating 12 arc-lamps, was installed. The following year a dynamo of 30 kw. capacity was installed at these falls by the Spokane Electric Light & Power Co. By 1899 the capacity at this location was 3,649 kw.

Another early hydroelectric power development in the Columbia Basin was the one at the falls of the Willamette River at Oregon City, where the Willamette Falls Electric Co. built a plant in 1889. This was one of the earliest commercial hydroelectric plants in the United States and had a capacity of 1,000 kw. These falls were used by Dr. John McLoughlin, chief factor of the Hudson's Bay Co., to furnish motive power for sawmills and other machinery as early as 1842.

Some idea of the rapid growth of the development and use of hydroelectric power in the Pacific Northwest can be gained by an inspection of table 17, which shows an increase in horsepower of prime movers from 56,280 in 1902 to 1,930,035 in 1932.

## IRRIGATION

Most of the area of the Columbia Basin east of the Cascade Mountains has a rainfall insufficient for crops other than grass and wheat, which must be raised in selected areas, and by dry-farming methods. Lands lying in the higher altitudes of the basin often have adequate precipitation, but the topography and prevailing temperatures make them unsuitable for agriculture. The streams draining these high parts of the basin pass through the lower arid portions, much of which consists of land extremely fertile when supplied with water. These circumstances have created a condition very favorable to the development of irrigation.

There are many small bodies of land in this region so conveniently situated that water can be diverted inexpensively from nearby streams in sufficient quantities to irrigate them. These were the first type of irrigation projects undertaken in the Columbia Basin and they were carried on by many of the earliest settlers of the district. In fact, Father John De Smet, a Jesuit missionary, apparently used water from two small streams in about 1846 or 1847 for irrigating such lands. This was at a location where Stevensville, Mont., now stands, and may have been the first attempt at irrigation in the arid portion of the Columbia Basin above the mouth of the Snake River.

Other situations conducive to irrigation activities are the low benchlands lying along stream channels. The development of these usually requires more expense than the preceding type and may take in quite large areas. Many of these have been accomplished by the joint efforts of groups of landowners or corporations. The majority of projects of this type were completed before 1900 but some of this work is still being carried on.

In addition to these two relatively inexpensive types of irrigation developments, there are great areas consisting of the level remains of old lake beds, or the gently sloping ridges into which they have eroded, high benches, wide alluvial cones at the debouchment of streams from the mountains, and in fact all of the possible irrigation sites which require large and expensive works to develop them. After 1903 the United States Bureau of Reclamation began to undertake such projects and there are now several either completed or in course of construction.

The settlement and irrigation of the arid lands of the Columbia Basin procceeded slowly after the arrival of the first settlers and was materially influenced by other developments in the region. At first the original settlers undertook small individual developments to insure their own domestic food supplies. Then local mining and lumbering operations created markets for foodstuffs. The construction of transcontinental railroads, the Northern Pacific in 1883 and the Great Northern in the early nineties, opened up a market in regions far distant from the area and many genuine farmer settlers than came into the basin.

After the first attempt at irrigation in the Columbia Basin above the mouth of the Snake River by Father John De Smet, the initial irrigation project below the mouth of the Snake River was apparently started in 1859 in the valley of the Walla Walla River; since water rights were determined by adjudication in that region at that time. In the John Day, Umatilla, and Hood River Valleys, adjudicated water rights were secured in the early sixties. The slowness with which irrigation developed in its first years in the Columbia Basin is shown by the fact that in 1889 there were only 400,000 acres under irrigation in that entire area. After 1889 the impetus of increased markets, railroad transportation, and demand for land by new settlers began to be felt, so that in 1934 there were approximately 4,000,000 acres irrigated in the Columbia drainage area. The estimated potential irrigable area is about 9,000,000 acres. Of the 4,000,000 acres under irrigation in 1934 about 277,000 acres were in the portion of the basin below the confluence of the Snake with the Columbia River.

### FLOOD CONTROL AND NAVIGATION

During recent years there has been much work proposed and some undertaken for the prevention of floods and the improvement of streams in the Columbia Basin for the purpose of navigation. The flood-control measures have been confined mainly to tributaries, and the navigation improvements to the main Columbia and Snake Rivers. Plans for flood control on small tributaries often call for the straightening of the stream channel, removal of snags and growth along the banks, and other activities which adversely affect the habitat of fish; particularly when the projects are carried on in streams which are spawning grounds for adult fish and areas of habitation for the young. The mechanics of the work itself are often harmful where gravel containing spawn is moved, or blasting powder is used. Dams play a principal part in the improvement of the main streams for navigation and in flood control in larger tributaries. These dams present the same hazards to fish life as those erected for power or irrigation purposes.

### GENERAL REMARKS

In this section the manner in which the utilization and development of various natural resources may influence the welfare and survival of populations of anadromous fishes, and the extent to which such activities have taken place in the Columbia Basin, have been briefly discussed. It is evident that these developments have taken place on a large scale in the Columbia River watershed and that they are practically all deleterious to the productivity and survival of the anadromous fish. Also, they have taken place coincidentally with the commercial exploitation of the fish populations. Therefore, the problem is one of maintaining the runs of salmon, with the number of spawners lessened by capture and the spawning areas diminished in size and curtailed in efficiency by factors connected with the development of other resources and industries. Also the effect of these unfavorable factors must be taken into account when considering the questions of any depletion which may have taken place.

The question of providing an adequate number of spawners can only be solved by regulation of the fishery. That of insuring the spawners of satisfactory spawning areas and their offspring the proper fresh-water environment is more difficult and complex. As a first step, unfavorable conditions now existing, such as pollution, unscreened diversions, inadequate fish protection at dams, and excessive removal of water from stream channels, should be rectified. In future developments of other land and water resources, plans in which the fisheries receive a just amount of consideration should be made, so that other industries will not be developed at the expense of one which is already important and well established. This situation presents an outstanding opportunity for sound, well-conceived, and coordinated planning.

## TOTAL SALMON PRODUCTION

After discussing the development and methods of the salmon fisheries of the Columbia, it should be of interest to consider the catch these fisheries have produced since their inception, and the factors which have brought about the fluctuations appearing from year to year in those catches. Since there are four species of salmon and the steelhead trout entering into the commercial fisheries of the Columbia, it appears advisable to present the records of the annual catches of each of these species before taking up the total combined catch.

The chinook salmon are by far the most important species in point of total poundage taken and value to the industry. Their yearly contribution to the river's total is shown in table 18.[5] The rapid expansion of the industry is reflected in the steep rise from the small beginning in 1866 to the all-time production peak of chinook salmon in 1883. It was during that period that the salmon-packing industry had its greatest development, the number of canneries increasing from 1 in 1866 and 1867 to 39 in 1883. There was a sharp drop in total catch from 42,799,200 pounds in 1883 to 18,135,396 pounds in 1889.

Table 18.—*Poundage of chinook salmon, canned and mild-cured, 1866 to 1936* [1]

| Year | Cases | Canned [2] | Mild-cured [3] | Total |
|---|---|---|---|---|
| | | *Pounds* | *Pounds* | *Pounds* |
| 1866 | 4,000 | 272,000 | | 272,000 |
| 1867 | 18,000 | 1,224,000 | | 1,224,000 |
| 1868 | 28,000 | 1,904,000 | | 1,904,000 |
| 1869 | 100,000 | 6,800,000 | | 6,800,000 |
| 1870 | 150,000 | 10,200,000 | | 10,200,000 |
| 1871 | 200,000 | 13,600,000 | | 13,600,000 |
| 1872 | 250,000 | 17,000,000 | | 17,000,000 |
| 1873 | 250,000 | 17,000,000 | | 17,000,000 |
| 1874 | 350,000 | 23,800,000 | | 23,800,000 |
| 1875 | 375,000 | 25,500,000 | | 25,500,000 |
| 1876 | 450,000 | 30,600,000 | | 30,600,000 |
| 1877 | [4]380,000 | 25,840,000 | | 25,840,000 |
| 1878 | 460,000 | 31,280,000 | | 31,280,000 |
| 1879 | 480,000 | 32,640,000 | | 32,640,000 |
| 1880 | 530,000 | 36,040,000 | | 36,040,000 |
| 1881 | 550,000 | 37,400,000 | | 37,400,000 |
| 1882 | 541,300 | 36,808,400 | | 36,808,400 |
| 1883 | 629,400 | 42,799,200 | | 42,799,200 |
| 1884 | 620,000 | 42,160,000 | | 42,160,000 |
| 1885 | 553,800 | 37,658,400 | | 37,658,400 |
| 1886 | 448,500 | 30,498,000 | | 30,498,000 |
| 1887 | 356,000 | 24,208,000 | | 24,208,000 |
| 1888 | 372,477 | 25,328,436 | | 25,328,436 |
| 1889 | 266,697 | 18,135,396 | | 18,135,396 |
| 1890 | 335,604 | 22,821,072 | | 22,821,072 |
| 1891 | 353,907 | 24,065,676 | | 24,065,676 |
| 1892 | 344,267 | 23,410,156 | | 23,410,156 |
| 1893 | 288,773 | 19,636,564 | | 19,636,564 |
| 1894 | 351,106 | 23,875,208 | | 23,875,208 |
| 1895 | 444,909 | 30,253,812 | | 30,253,812 |
| 1896 | 370,943 | 25,224,124 | | 25,224,124 |
| 1897 | 432,753 | 29,427,204 | 440,000 | 29,867,204 |
| 1898 | 329,566 | 22,410,488 | 770,000 | 23,180,488 |
| 1899 | 255,824 | 17,396,032 | 1,375,000 | 18,771,032 |
| 1900 | 262,392 | 17,842,656 | 1,402,500 | 19,245,156 |
| 1901 | | | 3,300,000 | |
| 1902 | 270,580 | 18,399,440 | 4,634,300 | 23,033,740 |
| 1903 | 301,762 | 20,519,816 | 7,397,500 | 27,917,316 |
| 1904 | 320,378 | 21,785,704 | 9,996,800 | 31,782,504 |
| 1905 | 327,106 | 22,243,208 | 10,785,500 | 33,028,708 |
| 1906 | 311,334 | 21,170,712 | 8,800,000 | 29,970,712 |
| 1907 | 258,433 | 17,573,444 | 6,677,000 | 24,250,444 |
| 1908 | 210,096 | 14,286,528 | 5,456,000 | 19,742,528 |
| 1909 | 162,131 | 11,024,908 | 6,094,000 | 17,118,908 |
| 1910 | 244,285 | 16,611,380 | 8,714,200 | 25,325,580 |
| 1911 | 405,862 | 27,598,616 | 9,003,500 | 36,602,116 |
| 1912 | 220,317 | 14,981,556 | 6,406,400 | 21,387,956 |
| 1913 | 192,116 | 13,063,888 | 6,320,600 | 19,384,488 |
| 1914 | 289,464 | 19,683,552 | 5,725,500 | 25,409,052 |
| 1915 | 406,486 | 27,641,048 | 4,485,800 | 32,126,848 |
| 1916 | 395,166 | 26,871,288 | 5,121,600 | 31,992,888 |
| 1917 | 403,637 | 27,447,316 | 2,074,600 | 29,521,916 |
| 1918 | 400,952 | 27,264,736 | 1,984,400 | 29,249,136 |
| 1919 | 392,125 | 26,664,500 | 3,660,800 | 30,325,300 |
| 1920 | 420,467 | 28,591,756 | 2,502,500 | 31,094,256 |
| 1921 | 267,582 | 18,195,576 | 3,356,100 | 21,551,676 |
| 1922 | 237,230 | 16,131,640 | 1,783,100 | 17,914,740 |
| 1923 | 289,586 | 19,691,848 | 1,886,500 | 21,578,348 |
| 1924 | 293,716 | 19,972,688 | 2,392,500 | 22,365,188 |
| 1925 | 350,809 | 23,855,012 | 2,805,000 | 26,660,012 |
| 1926 | 295,302 | 20,080,536 | 1,160,500 | 21,241,036 |
| 1927 | 339,446 | 23,082,328 | 928,400 | 24,010,728 |
| 1928 | 251,404 | 17,095,472 | 1,053,800 | 18,149,272 |
| 1929 | 242,938 | 16,519,784 | 1,631,300 | 18,151,084 |
| 1930 | 281,346 | 19,131,528 | 947,100 | 20,078,628 |
| 1931 | 294,798 | 20,046,264 | 1,332,100 | 21,378,364 |
| 1932 | 216,511 | 14,722,748 | 1,278,200 | 16,000,948 |
| 1933 | 251,157 | 17,078,676 | 2,449,700 | 19,528,376 |
| 1934 | 251,068 | 17,072,624 | 1,714,900 | 18,787,524 |
| 1935 | 205,870 | 13,999,160 | 1,267,200 | 15,266,360 |
| 1936 | 220,188 | 14,972,784 | 1,240,800 | 16,213,584 |

[1] Data from Pacific Fisherman Yearbooks.
[2] Poundage determined by using the conversion factor of 68 pounds of round fish per case.
[3] Converted on basis of 1,100 pounds of round fish per tierce.
[4] Jones (1888) and Collins (1892) give 460,000 cases packed.

One of the causes of this decline was a shortage of fish which began to be evident at that time. In the very early days of the industry the fishing was largely confined to the spring and early summer, when fish of the best quality were present in the river. The result was that these races of the chinook salmon soon began to show the result of the heavy fishing imposed upon them and to show signs of depletion, which were commented upon as early as the late seventies.

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[5] All of the figures of total catch presented in this section were compiled from records of canned, frozen, and mild-cured packs. Conversion factors were used to change those values to equivalent poundages of round fish. This procedure was followed because there are no existing continuous records of the actual landings in pounds of round fish from the inception of the industry to the present time. All available records were secured for this compilation and they were checked, one against the other, so it is felt that the data presented give a reasonably accurate picture of the yield of the Columbia River salmon fisheries from 1866 to 1936, inclusive.

Also, it was during this period that the number of canneries declined from 39 to 21. This decline was largely due to the business becoming less profitable because of higher prices paid to the fishermen for the salmon and a growing competition in the world's markets from salmon canned in other areas. The curtailment of the canning industry probably resulted in a lessened fishing effort. During these early years of the fishery all of the fish canned were reported as chinook salmon. This classification was doubtless accurate enough for all practical purposes, since the fishing was done almost entirely in the early part of the season when no silver or chum salmon were present in the river. However, a few steelhead trout may have entered into the pack and there is evidence that small amounts of silver and chum salmon were packed as early as 1885 and 1886. Apparently the bluebacks were not utilized until 1889, at which time they were reported as such.

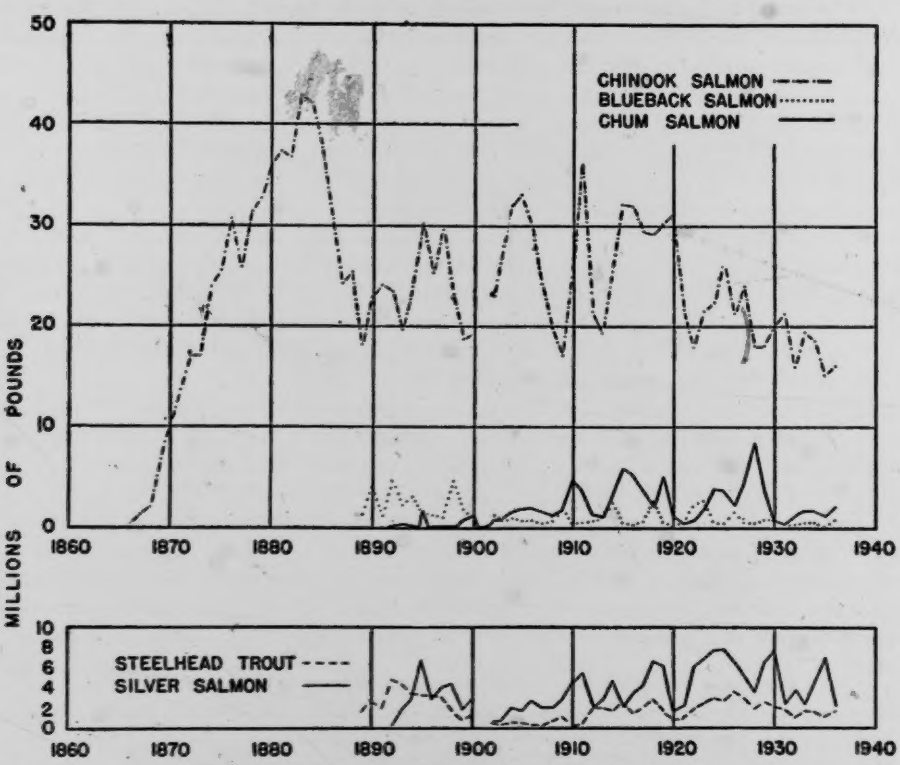

FIGURE 16.—Columbia River salmon and steelhead trout production.

The period from 1890 to 1910 was one in which the annual catch of chinook salmon fluctuated widely and did not show either a rising or falling trend. During that time industry, agriculture, and civilization in general were bringing about a gradual curtailment of the spawning grounds, which adversely affected the populations of chinook salmon. The total catch tended to maintain its level because the less desirable races of chinooks entering the river during August and September were fished with increasing intensity and fishing gear and methods were being improved and made more efficient.

There were many large fluctuations in the catches from 1911 to 1935, but the trend was definitely downward. This took place despite further improvements in fishing gear and full exploitation of the August and September runs which came about in those later years. It is often dangerous to draw conclusions regarding the abundance of fish from gross total catch figures, but apparently the chinook salmon have declined in abundance from 1911 to the present time. When the destruction and curtailment of spawning grounds and the intensity of the fishery is considered, such a condition does not appear surprising.

The trend of the mild-cure pack shown in table 18 is in no way related to the abundance of the chinook salmon, its fluctuations being due largely to economic and market conditions. At times, however, a scarcity of large fish suitable for mild-curing has occurred. Also, in recent years troll-caught fish have been mild-cured along the coast. The principal market for this product was in Europe, with Germany taking most of the pack. The advent of the World War made it impossible to continue this commerce and, since the conclusion of the war, conditions in Germany have been such that the trade could not be reestablished.

The annual total catches of blueback salmon presented in table 19 show wide fluctuations from year to year, but despite this variability some conclusions regarding the trend of this fishery appear to be warranted. The level of the catch from 1889 to 1900 was considerably higher than that of any of the succeeding periods. Then from 1900 to 1923 there was a period of stability with a slightly rising trend, which was followed by a definitely downward movement from 1923 to 1936.

The removal of the fish wheels from the Oregon shore of the river in 1927 probably accounts for a part of the decline in the catches from 1927 to 1936, but the major factor in the decreasing take of this species was a growing scarcity of fish. The intensity of the fishery no doubt had some part in causing the depletion of the blueback population. A more important factor, however, was the blocking off of many of the spawning grounds of the bluebacks by dams. During the course of irrigation, power, lumbering, and mining developments, dams were built on tributaries of the Yakima, and Salmon Rivers, and across the Wenatchee and Wallowa, which caused important blueback spawning areas to be either entirely obstructed or very difficult of access.

TABLE 19.—*Poundage of blueback salmon, canned, 1889 to 1936* [1]

| Year | Cases | Pounds [2] | Year | Cases | Pounds [2] | Year | Cases | Pounds [2] |
|---|---|---|---|---|---|---|---|---|
| 1889 | 17,797 | 1,210,196 | 1905 | 7,768 | 528,224 | 1921 | 6,045 | 411,060 |
| 1890 | 57,345 | 3,899,460 | 1906 | 7,816 | 531,488 | 1922 | 30,743 | 2,090,524 |
| 1891 | 15,482 | 1,052,776 | 1907 | 5,504 | 374,272 | 1923 | 38,309 | 2,605,012 |
| 1892 | 66,547 | 4,525,196 | 1908 | 8,581 | 583,508 | | | |
| 1893 | 30,459 | 2,071,212 | | | | 1924 | 7,366 | 500,888 |
| | | | 1909 | 25,062 | 1,704,216 | 1925 | 5,650 | 384,200 |
| 1894 | 43,814 | 2,979,352 | 1910 | 6,234 | 423,912 | 1926 | 21,736 | 1,478,048 |
| 1895 | 18,015 | 1,225,020 | 1911 | 5,988 | 407,184 | 1927 | 6,887 | 468,316 |
| 1896 | 16,983 | 1,154,844 | 1912 | 8,210 | 558,280 | 1928 | 4,814 | 327,352 |
| 1897 | 12,972 | 882,096 | 1913 | 11,152 | 758,336 | | | |
| 1898 | 66,670 | 4,533,560 | | | | 1929 | 10,072 | 684,896 |
| | | | 1914 | 35,311 | 2,401,148 | 1930 | 9,823 | 667,964 |
| 1899 | 23,969 | 1,629,892 | 1915 | 5,459 | 371,212 | 1931 | 4,125 | 280,500 |
| 1900 | 13,162 | 895,016 | 1916 | 3,790 | 257,720 | 1932 | 2,795 | 190,060 |
| 1901 | -------- | -------- | 1917 | 7,968 | 541,824 | 1933 | 6,921 | 470,628 |
| 1902 | 17,037 | 1,158,516 | 1918 | 37,833 | 2,572,644 | | | |
| 1903 | 8,383 | 570,044 | | | | 1934 | 6,869 | 467,092 |
| | | | 1919 | 7,268 | 494,224 | 1935 | 1,302 | 88,536 |
| 1904 | 12,911 | 877,948 | 1920 | 2,617 | 177,956 | 1936 | 9,837 | 668,916 |

[1] Data from Cobb, 1889–1926; from Pacific Fisherman, 1929–36.

[2] Poundage determined by using the conversion factor of 68 pounds of round fish per case of 48 1-pound cans.

The habits of the bluebacks are such that the adults normally go to a tributary above a lake to deposit their eggs. The young, after emerging from the gravel, go down the stream and into the lake where they spend their entire fresh-water existence until they are ready to go out of the lake into the sea. Apparently the young bluebacks are not well adapted to residence in streams and require the lakes during their early existence. Also, this species displays a marked ability to return to its parent tributary to spawn. Therefore, when the above-mentioned dams made it difficult or impossible for the adult bluebacks to reach the lakes above them, the races frequenting those lakes were either badly depleted or completely destroyed.

It is not possible to draw any conclusions regarding the relative abundance of the chum salmon from the data shown in table 20. This species is apparently liable to wide natural fluctuations in abundance and the size of the annual take is often largely dependent on the market demand for cheap fish, the chums providing the lowest grade canned salmon of any of the species taken on the river.

TABLE 20.—*Poundage of chum salmon canned, 1893 to 1936* [1]

| Year | Cases | Pounds [2] | Year | Cases | Pounds [2] | Year | Cases | Pounds [2] |
|---|---|---|---|---|---|---|---|---|
| 1893 | 2,311 | 157,148 | 1911 | 53,471 | 3,636,028 | 1926 | 32,853 | 2,234,004 |
| | | | 1912 | 18,699 | 1,271,532 | 1927 | 68,449 | 4,654,532 |
| 1895 | 22,493 | 1,529,524 | 1913 | 13,303 | 904,604 | 1928 | 124,953 | 8,496,804 |
| | | | 1914 | 49,285 | 3,351,380 | 1929 | 54,619 | 3,714,092 |
| 1899 | 11,379 | 773,772 | 1915 | 86,530 | 5,884,040 | 1930 | 11,371 | 773,228 |
| 1900 | 17,696 | 1,203,328 | | | | | | |
| | | | 1916 | 77,766 | 5,288,088 | 1931 | 3,518 | 239,224 |
| 1902 | 10,401 | 707,268 | 1917 | 53,659 | 3,648,812 | 1932 | 17,261 | 1,173,748 |
| 1903 | 10,000 | 680,000 | 1918 | 29,846 | 2,029,528 | 1933 | 24,398 | 1,659,064 |
| 1904 | 20,693 | 1,407,124 | 1919 | 75,493 | 5,133,524 | 1934 | 24,455 | 1,662,940 |
| 1905 | 25,751 | 1,751,068 | 1920 | 18,792 | 1,277,856 | 1935 | 15,495 | 1,053,660 |
| 1906 | 27,802 | 1,890,536 | 1921 | 4,821 | 327,828 | 1936 | 30,597 | 2,080,596 |
| 1907 | 22,556 | 1,533,808 | 1922 | 8,844 | 601,392 | | | |
| 1908 | 16,884 | 1,148,112 | 1923 | 25,508 | 1,734,544 | | | |
| 1909 | 24,542 | 1,668,856 | 1924 | 57,748 | 3,926,864 | | | |
| 1910 | 66,538 | 4,524,584 | 1925 | 55,812 | 3,795,216 | | | |

[1] Data from Cobb, 1893–1928; from Pacific Fisherman, 1929–36.
[2] Poundage determined by using the conversion factor of 68 pounds of round fish per case of 48 1-pound cans.

TABLE 21.—*Poundage of steelhead trout, canned and frozen, 1889 to 1936* [1]

| Year | Cases | Canned [2] | Frozen | Total | Year | Cases | Canned [2] | Frozen | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | *Pounds* | *Pounds* | *Pounds* | | | *Pounds* | *Pounds* | *Pounds* |
| 1889 | 25,391 | 1,726,588 | | 1,726,588 | 1913 | 8,939 | 607,852 | 1,560,000 | 2,167,852 |
| 1890 | 42,825 | 2,912,100 | | 2,912,100 | 1914 | 10,792 | 733,856 | 1,173,741 | 1,907,597 |
| | | | | | 1915 | 26,723 | 1,817,164 | 873,001 | 2,690,165 |
| 1891 | 29,564 | 2,010,352 | | 2,010,352 | 1916 | 18,999 | 1,291,932 | 289,000 | 1,580,932 |
| 1892 | 72,348 | 4,919,664 | | 4,919,664 | 1917 | 23,783 | 1,617,244 | 615,858 | 2,233,102 |
| 1893 | 65,226 | 4,435,368 | | 4,435,368 | 1918 | 24,605 | 1,673,140 | 1,349,466 | 3,022,606 |
| 1894 | 52,422 | 3,564,696 | | 3,564,696 | 1919 | 14,414 | 980,152 | 919,793 | 1,899,945 |
| 1895 | 49,678 | 3,378,104 | | 3,378,104 | 1920 | 12,645 | 859,860 | 306,000 | 1,165,860 |
| 1896 | 49,663 | 3,377,084 | | 3,377,084 | | | | | |
| 1897 | 46,146 | 3,137,928 | | 3,137,928 | 1921 | 10,142 | 689,656 | 331,419 | 1,021,075 |
| 1898 | 26,277 | 1,786,836 | | 1,786,836 | 1922 | 24,920 | 1,694,560 | 468,225 | 2,162,785 |
| 1899 | 11,994 | 815,592 | | 815,592 | 1923 | 25,968 | 1,765,824 | 918,450 | 2,684,274 |
| 1900 | 20,597 | 1,400,596 | | 1,400,596 | 1924 | 29,734 | 2,021,912 | 1,170,905 | 3,192,817 |
| | | | | | 1925 | 14,637 | 995,316 | 1,911,844 | 2,907,160 |
| 1901 | | | | | 1926 | 32,690 | 2,222,920 | 1,620,143 | 3,843,063 |
| 1902 | 8,593 | 584,324 | | 584,324 | 1927 | 30,148 | 2,050,064 | 1,097,187 | 3,147,251 |
| 1903 | 7,251 | 493,068 | | 493,068 | 1928 | 16,339 | 1,111,052 | 1,049,098 | 2,160,150 |
| 1904 | 9,868 | 671,024 | | 671,024 | 1929 | 23,804 | 1,618,672 | 1,251,425 | 2,870,097 |
| 1905 | 9,822 | 667,896 | | 667,896 | 1930 | 16,535 | 1,124,380 | 1,279,737 | 2,404,117 |
| 1906 | 6,500 | 442,000 | | 442,000 | | | | | |
| 1907 | 5,921 | 402,628 | | 402,628 | 1931 | 11,990 | 815,320 | 1,310,708 | 2,126,028 |
| 1908 | 10,726 | 729,368 | | 729,368 | 1932 | 13,132 | 892,976 | 538,795 | 1,431,771 |
| 1909 | 17,283 | 1,175,244 | | 1,175,244 | 1933 | 17,805 | 1,210,740 | 747,563 | 1,958,303 |
| 1910 | 5,436 | 369,648 | | 369,648 | 1934 | 14,901 | 1,013,268 | 905,916 | 1,919,184 |
| | | | | | 1935 | 14,888 | 1,012,384 | 459,847 | 1,472,231 |
| 1911 | 8,594 | 584,392 | | 584,392 | 1936 | 19,282 | 1,311,176 | 629,596 | 1,940,772 |
| 1912 | 6,958 | 473,144 | 1,674,030 | 2,147,174 | | | | | |

[1] Data from Cobb, 1889–1928; from Pacific Fisherman, 1929–36; frozen pack from Pacific Fisherman.
[2] Poundage canned determined by using the conversion factor of 68 pounds of round fish per case of 48 1-pound cans.

The yearly steelhead-trout catches presented in table 21 fail to display any significant trend except during the last few years, from 1926 to 1936, when the annual take dropped from almost 4,000,000 pounds to about 2,000,000 pounds. There were several causes that have probably contributed to this decline. One of these was the classification of steelhead trout as a game fish by the State of Washington in 1929, which act somewhat curtailed the exploitation of the species on the Washington side of the Columbia. Another influencing factor had to do with the frozen steelhead-trout trade (see table 21), which disposes of about one-half of the total catch. Until a few years ago a large part of the frozen steelheads were disposed of in Europe, but recent unfavorable conditions have curtailed this foreign trade. The steelheads have also suffered a considerable loss of spawning grounds, in common with the other anadromous fishes of the Columbia.

The yearly catches of silver salmon display a rising trend from 1902 to 1924, after which their direction is, in general, downward, with several large fluctuations. The most significant development in this fishery has been the increasingly important role which trolling has assumed. It will be remembered that trolling began to be an important fishery in the Columbia River region in 1915. Since that time the amount of silver salmon landed by the trollers has increased so that from 1927 to 1934, inclusive, the catch of that type of gear was from approximately 49 to 77 percent of the annual catch. Therefore, it is evident that the trolling fleet has been the main factor in the increase of the silver salmon landings and the maintenance of the present level of annual catch.

TABLE 22.—*Poundage of silver salmon, canned and mild-cured, 1892 to 1936* [1]

| Year | Cases | Canned [2] | Mild-cured [3] | Total |
|---|---|---|---|---|
| | | *Pounds* | *Pounds* | *Pounds* |
| 1892 | 4,176 | 283,968 | ---------- | 283,968 |
| 1893 | 29,107 | 1,979,276 | ---------- | 1,979,276 |
| 1894 | 42,758 | 2,907,544 | ---------- | 2,907,544 |
| 1895 | 99,601 | 6,772,868 | ---------- | 6,772,868 |
| 1896 | 44,108 | 2,999,344 | ---------- | 2,999,344 |
| 1897 | 60,850 | 4,137,800 | ---------- | 4,137,800 |
| 1898 | 65,431 | 4,449,308 | ---------- | 4,449,308 |
| 1899 | 29,608 | 2,013,344 | ---------- | 2,013,344 |
| 1900 | 44,925 | 3,054,900 | ---------- | 3,054,900 |
| 1901 | ---------- | ---------- | ---------- | ---------- |
| 1902 | 10,532 | 716,176 | ---------- | 716,176 |
| 1903 | 12,181 | 828,308 | ---------- | 828,308 |
| 1904 | 31,254 | 2,125,272 | ---------- | 2,125,272 |
| 1905 | 26,826 | 1,824,168 | ---------- | 1,824,168 |
| 1906 | 41,446 | 2,818,328 | ---------- | 2,818,328 |
| 1907 | 31,757 | 2,159,476 | ---------- | 2,159,476 |
| 1908 | 31,432 | 2,137,376 | ---------- | 2,137,376 |
| 1909 | 42,178 | 2,868,104 | ---------- | 2,868,104 |
| 1910 | 68,922 | 4,686,696 | ---------- | 4,686,696 |
| 1911 | 79,416 | 5,400,288 | ---------- | 5,400,288 |
| 1912 | 31,842 | 2,165,256 | ---------- | 2,165,256 |
| 1913 | 40,969 | 2,785,892 | ---------- | 2,785,892 |
| 1914 | 69,769 | 4,744,292 | ---------- | 4,744,292 |
| 1915 | 33,336 | 2,266,848 | ---------- | 2,266,848 |
| 1916 | 52,084 | 3,541,712 | ---------- | 3,541,712 |
| 1917 | 64,299 | 4,372,332 | ---------- | 4,372,332 |
| 1918 | 98,145 | 6,673,860 | ---------- | 6,673,860 |
| 1919 | 90,728 | 6,169,504 | ---------- | 6,169,504 |
| 1920 | 27,024 | 1,837,632 | ---------- | 1,837,632 |
| 1921 | 34,381 | 2,337,908 | ---------- | 2,337,908 |
| 1922 | 90,437 | 6,149,716 | ---------- | 6,149,716 |
| 1923 | 101,554 | 6,905,672 | 59,400 | 6,965,072 |
| 1924 | 112,308 | 7,636,944 | 159,500 | 7,796,444 |
| 1925 | 113,544 | 7,720,992 | 215,600 | 7,936,592 |
| 1926 | 97,142 | 6,605,656 | ---------- | 6,605,656 |
| 1927 | 74,879 | 5,091,772 | 117,700 | 5,209,472 |
| 1928 | 49,136 | 3,341,248 | 381,700 | 3,722,948 |
| 1929 | 90,684 | 6,166,512 | 534,600 | 6,701,112 |
| 1930 | 110,430 | 7,509,240 | 227,700 | 7,736,940 |
| 1931 | 39,268 | 2,670,224 | 44,000 | 2,714,224 |
| 1932 | 46,492 | 3,161,456 | 935,000 | 4,096,456 |
| 1933 | 36,430 | 2,477,240 | 224,400 | 2,701,640 |
| 1934 | 65,428 | 4,449,104 | 325,600 | 4,774,704 |
| 1935 | 95,184 | 6,472,512 | 635,800 | 7,108,312 |
| 1936 | 36,541 | 2,484,788 | 11,000 | 2,495,788 |

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[1] Data cases packed, 1892–1928 from Cobb; 1929–36, Pacific Fisherman; mild-cure pack from Pacific Fisherman.
[2] Poundage determined by using the conversion factor of 68 lbs. of round fish per case of 48 1-pound cans.
[3] Tierces converted on the basis of 1,100 pounds of round fish per tierce.

Table 23, showing the yearly catches of all species of salmon and steelhead trout, presents a summation of the detailed catch data for each species which have been given in the several preceding tables with the addition of the frozen salmon production. This trend of production is necessarily very similar to that of the chinook salmon, since that species provides the major portion of the total catch. From 1930 to 1936, inclusive, approximately 70 percent of the entire catch was chinook salmon. However, it is interesting to note that the addition of the other species since about 1890 has tended to keep the catch up to a fairly even level without the pronounced decline which is evident in the chinook records.

These data also indicate that from 1883 to 1936 the populations of salmon and steelhead trout inhabiting the Columbia have provided approximately 23,000,000 to 49,000,000 pounds of foodfish annually. The present annual income from this fishery has been estimated as being about $10,000,000, and several thousand persons are furnished employment by the industry. The fisheries of the Columbia provided food for the inhabitants of the region long before the white men arrived, and the fact that they have been able not only to continue to do that but also to supply large amounts of canned salmon to the world's markets, even under present unfavorable conditions, points to the conclusion that the resource can be preserved if proper planning and conservation measures are followed.

TABLE 23.—*Columbia River salmon and steelhead trout production, 1866 to 1936* [1]

| Year | Canned [2] | Mild-cured [3] | Frozen | Total |
|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| 1866 | 272,000 | | | 272,000 |
| 1867 | 1,224,000 | | | 1,224,000 |
| 1868 | 1,904,000 | | | 1,904,000 |
| 1869 | 6,800,000 | | | 6,800,000 |
| 1870 | 10,200,000 | | | 10,200,000 |
| 1871 | 13,600,000 | | | 13,600,000 |
| 1872 | 17,000,000 | | | 17,000,000 |
| 1873 | 17,000,000 | | | 17,000,000 |
| 1874 | 23,800,000 | | | 23,800,000 |
| 1875 | 25,500,000 | | | 25,500,000 |
| 1876 | 30,600,000 | | | 30,600,000 |
| 1877 | 25,840,000 | | | 25,840,000 |
| 1878 | 31,280,000 | | | 31,280,000 |
| 1879 | 32,640,000 | | | 32,640,000 |
| 1880 | 36,040,000 | | | 36,040,000 |
| 1881 | 37,400,000 | | | 37,400,000 |
| 1882 | 36,808,400 | | | 36,808,400 |
| 1883 | 42,799,200 | | | 42,799,200 |
| 1884 | 42,160,000 | | | 42,160,000 |
| 1885 | 37,658,400 | | | 37,658,400 |
| 1886 | 30,498,000 | | | 30,498,000 |
| 1887 | 24,208,000 | | | 24,208,000 |
| 1888 | 25,328,436 | | | 25,328,436 |
| 1889 | 21,072,180 | | | 21,072,180 |
| 1890 | 29,632,632 | | | 29,632,632 |
| 1891 | 27,128,804 | | | 27,128,804 |
| 1892 | 33,138,984 | | | 33,138,984 |
| 1893 | 28,279,568 | | | 28,279,568 |
| 1894 | 33,326,800 | | | 33,326,800 |
| 1895 | 43,159,328 | | | 43,159,328 |
| 1896 | 32,755,396 | | | 32,755,396 |
| 1897 | 37,585,028 | 440,000 | | 38,025,028 |
| 1898 | 33,180,192 | 770,000 | | 33,950,192 |
| 1899 | 22,628,632 | 1,375,000 | | 24,003,632 |
| 1900 | 24,396,496 | 1,402,500 | | 25,798,996 |
| 1901 | 26,532,444 | 3,300,000 | | 29,832,444 |
| 1902 | 21,565,724 | 4,634,300 | | 26,200,024 |
| 1903 | 23,091,236 | 7,397,500 | | 30,488,736 |
| 1904 | 26,867,072 | 9,996,800 | | 36,863,872 |
| 1905 | 27,014,564 | 10,785,500 | | 37,800,064 |
| 1906 | 26,853,064 | 8,800,000 | | 35,653,064 |
| 1907 | 22,043,628 | 6,677,000 | | 28,720,628 |
| 1908 | 18,884,892 | 5,456,000 | | 24,340,892 |
| 1909 | 18,441,328 | 6,094,000 | | 24,535,328 |
| 1910 | 26,616,220 | 8,714,200 | | 35,330,420 |
| 1911 | 37,626,508 | 9,003,500 | 2,850,000 | 49,480,008 |
| 1912 | 19,449,768 | 6,406,400 | 1,674,030 | 27,530,198 |
| 1913 | 18,120,572 | 6,320,600 | 2,115,000 | 26,556,172 |
| 1914 | 30,914,228 | 5,725,500 | 1,861,575 | 38,501,303 |
| 1915 | 37,980,312 | 4,485,800 | 1,372,568 | 43,838,680 |
| 1916 | 37,250,740 | 5,121,600 | 374,000 | 42,746,340 |
| 1917 | 37,627,528 | 2,074,600 | 745,858 | 40,447,986 |
| 1918 | 40,213,908 | 1,984,400 | 1,927,115 | 44,125,423 |
| 1919 | 39,441,904 | 3,660,800 | 1,831,793 | 44,934,497 |
| 1920 | 32,745,060 | 2,502,500 | 1,064,000 | 36,311,560 |
| 1921 | 21,962,028 | 3,356,100 | 1,394,419 | 26,712,547 |
| 1922 | 26,667,832 | 1,783,100 | 1,701,725 | 30,152,657 |
| 1923 | 32,702,900 | 1,945,900 | 1,018,450 | 35,667,250 |
| 1924 | 34,059,296 | 2,552,000 | 1,555,758 | 38,167,054 |
| 1925 | 36,750,736 | 3,020,600 | 2,562,107 | 42,333,443 |
| 1926 | 32,621,164 | 1,160,500 | 1,784,995 | 35,566,659 |
| 1927 | 35,347,012 | 1,046,100 | 1,295,303 | 37,688,415 |
| 1928 | 30,371,928 | 1,435,500 | 1,319,638 | 33,127,066 |
| 1929 | 28,703,956 | 2,165,900 | 1,451,425 | 32,321,281 |
| 1930 | 29,206,340 | 1,174,800 | 1,542,259 | 31,923,399 |
| 1931 | 24,051,532 | 1,376,100 | 1,604,208 | 27,031,840 |
| 1932 | 20,140,988 | 2,213,200 | 976,029 | 23,330,217 |
| 1933 | 22,896,348 | 2,674,100 | 1,276,352 | 26,846,800 |
| 1934 | 24,665,028 | 2,040,500 | 1,196,409 | 27,901,937 |
| 1935 | 22,626,252 | 1,903,000 | 1,226,754 | 25,756,006 |
| 1936 | 21,518,260 | 1,251,800 | 758,518 | 23,528,578 |

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[1] Data from Pacific Fisherman yearbooks. Not total production, which would have to include fish consumed fresh, etc.
[2] Converted on basis of 68 pounds of round fish per case of 48 1-pound cans.
[3] Converted on basis of 1,100 pounds of round fish per tierce.

## SHAD FISHERY OF COLUMBIA RIVER BASIN

Shad, *Alosa sapidissima*, are an anadromous species of the herring family and are native to the Atlantic coast of North America from Florida to Newfoundland. Their introduction into the waters of the Pacific coast is one of the few existing examples of the successful introduction of a desirable and important species of fish into a new habitat. The initial plant of these fish on the Pacific coast was made in the Sacramento River in 1871. Soon after that date, in about 1876 or 1877, a few shad began to appear in the Columbia. These fish were evidently results of the Sacramento River planting, because at that time no shad had been planted in the Columbia River system.

The first planting of shad in the Columbia Basin came about through the failure of arrangements made to plant in another locality. This occurred in 1885 when 900,000 shad fry were shipped from the Atlantic coast for the purpose of stocking tributaries to Puget Sound in the State of Washington. This shipment was delayed so long en route that nearly all of the young fish were lost and the original plan was abandoned. The result was that 50,000 of the fry were planted in the Willamette River at Portland, Oreg., and the remaining 10,000 in the Snake River near its junction with the Columbia at Ainsworth, Wash. The following year 550,000 fry were planted in the Willamette River at Albany, Oreg., and 300,000 in the Columbia at Wallula Junction, Wash., making a total of 910,000 shad fry planted in the streams of the Columbia Basin in 1885 and 1886. No further plantings have been made, so the successful introduction of the shad into the Columbia River must be attributed to those plants and whatever adults that migrated into that stream from the populations of the Sacramento River and other locations south of the Columbia.

The success of the attempts to establish shad in an entirely new habitat was indeed remarkable. In 1888 a noticeable catch of shad was made by the traps in Baker Bay, and the following year they were taken by haul seines about 80 miles up the river. The incidental catches of shad and the average size of the fish continued to increase for the next few years. By 1893 these fish were so numerous, and their market value so low, that large quantities of both young and adults were destroyed by seiners and trap men. It is a strange circumstance that this fish, which is regarded as a great delicacy on the Atlantic seaboard and which demands a high price in the markets of that region, has never been favorably received as a food fish by the people of the Pacific coast. Some shad are consumed locally and from time to time quantities are shipped, iced or frozen, to points as far distant as the Atlantic coast cities, but this demand has never been of sufficient strength to raise the price to a level high enough so that shad fishing could be profitably and continuously carried on as a major fishery in the Columbia. An experimental pack of canned shad was put up in 1895 and some of the fish are preserved in that manner at the present time. The roe is also canned and brings a good price. The pack of shad and roe from 1920 to 1934, inclusive, is shown in table 24.

TABLE 24.—*Columbia River canned shad and shad roe pack, 1913 to 1936* [1]

| Year | Shad | Shad roe | Total |
|---|---|---|---|
| | *Cases* [2] | *Cases* [3] | *Cases* |
| 1913 | | | 5,852 |
| 1914 | | | 3,248 |
| 1915 | | | 3,748 |
| 1916 | | | 2,450 |
| 1917 | | | 4,419 |
| 1918 | | | 6,971 |
| 1919 | | | 9,666 |
| 1920 | 8,251 | 446 | 8,697 |
| 1921 | 871 | 3 | 874 |
| 1922 | 1,410 | 87 | 1,497 |
| 1923 | 2,128 | 413 | 2,541 |
| 1924 | 4,478 | 150 | 4,628 |
| 1925 | 6,120 | 836 | 6,956 |
| 1926 | 14,457 | 708 | 15,165 |
| 1927 | 16,081 | 415 | 16,496 |
| 1928 | 17,560 | 1,632 | 19,192 |
| 1929 | 15,944 | 2,315 | 18,259 |
| 1930 | 10,783 | 862 | 11,645 |
| 1931 | 757 | 1,078 | 1,835 |
| 1932 | 361 | 807 | 1,168 |
| 1933 | 1,020 | 488 | 1,508 |
| 1934 | 8,098 | 1,651 | 9,749 |
| 1935 | 5,495 | 1,030 | 6,525 |
| 1936 | 4,131 | 1,002 | 5,133 |
| Total | 117,945 | 13,923 | 168,222 |

[1] Data from Pacific Fisherman yearbooks.

[2] Case of 48 1-pound cans.

[3] ½-pound flats and ovals (8 dozen).

The lack of demand has resulted in shad fishing being largely incidental to the salmon fishery. The fishermen receive only from 1 to 3 cents a pound for the fish and at times buyers will not take the buck, or male shad, accepting only the females which contain the roe. In the early days of the fishery the traps, seines, and wheels took most of the shad, but in more recent years the haul seines and drift gill nets have taken the greater portion. A few gill-net fishermen own and fish small-mesh shad nets, but such fishermen are not numerous. Since the shad run occurs during the same months that the spring and summer fishing for salmon is carried on, most of the fishermen feel that they can secure better financial returns by pursuing the more valuable salmon.

Shad are abundant in all of the lower portions of the river and are taken in large quantities up to Cascade Rapids, about 150 miles from the ocean. A few small catches have been made as far upstream as The Dalles, and Celilo Falls may mark their farthest point of occurrence in the upper river in significant numbers.

## PRODUCTION AND COMMERCIAL IMPORTANCE

Because of the facts just related, it is evident that the total catch figures presented in table 25 are not in any sense an index of the abundance or maximum productivity of the shad population of the Columbia. They are more nearly an index of the demand for or rate of disposal of the shad. It will be noted that the total catch maintained its highest level from 1926 to 1930, inclusive. Inspection of the canned pack figures also indicates that those years marked the maximum period of production of the canned product. It evidently became difficult to dispose of this pack during the depression years but it is possible that the market may revive in the future.

TABLE 25.—*Shad production of the Columbia River* [1]

| Year | Washington | Oregon | Total |
|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* |
| 1889 | 20,010 | 29,990 | 50,000 |
| 1890 | 34,930 | 50,100 | 85,030 |
| 1891 | 58,888 | 70,500 | 129,388 |
| 1892 | 102,250 | 109,000 | 211,250 |
| 1895 | | [2] 165,800 | |
| 1896 | 442,500 | 442,500 | 885,000 |
| 1897 | 218,000 | 450,500 | 668,500 |
| 1898 | 227,000 | 215,000 | 442,000 |
| 1899 | [2] 126,000 | [2] 275,380 | [2] 401,380 |
| 1900 | 166,100 | 295,760 | 461,860 |
| 1901 | | 140,249 | |
| 1902 | 240,000 | 102,583 | 342,583 |
| 1903 | 20,000 | 100,775 | 120,775 |
| 1904 | [3] 125,287 | 26,846 | 152,133 |
| 1905 | 45,000 | 94,493 | 139,493 |
| 1906 | 45,000 | 183,700 | 228,700 |
| 1907 | 45,000 | 235,956 | 280,956 |
| 1908 | 45,000 | 496,229 | 541,229 |
| 1909 | 47,000 | 374,566 | 421,566 |
| 1910 | 40,000 | 273,346 | 313,346 |
| 1911 | 40,000 | | |
| 1912 | 40,000 | | |
| 1915 | [3] 91,937 | 488,625 | 580,562 |
| 1916 | 3,270 | | |
| 1917 | 137,674 | | |
| 1918 | 223,233 | | |
| 1919 | 220,700 | | |
| 1923 | 88,289 | 246,179 | 334,468 |
| 1925 | 254,610 | 410,527 | 665,137 |
| 1926 | 380,458 | 999,464 | 1,379,922 |
| 1927 | 325,701 | 785,495 | 1,111,196 |
| 1928 | 515,423 | 697,296 | 1,212,719 |
| 1929 | 490,607 | 885,481 | 1,376,088 |
| 1930 | 531,815 | 832,518 | 1,364,333 |
| 1931 | 268,363 | 590,190 | 858,553 |
| 1932 | 100,627 | 218,289 | 318,916 |
| 1933 | 87,529 | 127,322 | 214,851 |
| 1934 | 171,100 | 488,500 | 659,600 |

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[1] Data for the following years from State Reports: 1895–1903, 1905–12, 1916–19. Data for the following years from Report of Fishery Industries: 1889–92, 1904, 1915, 1923, 1925–34.

[2] Report of Fishery Industries for 1895: For Oregon, 125,246 pounds; and, in 1899, for Washington, 85,000 pounds; for Oregon, 32,000 pounds, totaling 117,000 pounds.

[3] State Report for Washington gives catch for 1904 as 40,000 pounds, and in 1915, 24,846 pounds.

## STURGEON FISHERY OF COLUMBIA RIVER BASIN

There are two species of sturgeon inhabiting the Columbia and entering into the commercial catch of the region. These are the white sturgeon. *Acipenser transmontanus*, and the green sturgeon, *Acipenser medirostris*. The white sturgeon is larger than the green, having a maximum weight of over 1,000 pounds, while the green sturgeon seldom weighs over 350 pounds. There is also a considerable difference in the quality of the flesh of the two species, the white sturgeon being the more desirable as a food fish and commanding a higher price in the market. In fact, for a good many years, the flesh of the green sturgeon was considered to be unfit for human consumption, or even poisonous, and none were purchased from the fishermen.

Both species are anadromous, depositing their eggs in fresh water and spending portions of their life in the sea. They probably do not adhere to the clear-cut distinction between fresh- and salt-water residence that is so marked in the salmon. This appears to be the case since sturgeon of every size are found in the river at all seasons of the year and, as will be pointed out later, certain sections of the upper river were depleted of large sturgeon in the order in which they were used for fishing grounds, thus indicating that there was not a marked migration of those larger fish.

### DEVELOPMENT OF STURGEON FISHERY

Some of the first explorers mention purchasing sturgeon from the Indians. They were evidently used for food by the original inhabitants of the region and, during the early development of the Columbia Basin, the white settlers probably caught some sturgeon for their own tables. As late as 1874 the Weekly Astorian carried a news item stating that a sturgeon weighing 1,250 pounds was landed in Astoria, and that the entire fish was sold for the sum of 25 cents. Evidently sturgeon did not command a high price in those days.

However, by 1880 the sturgeon fishery had started in a small way. In addition to the rather insignificant amount used locally in a fresh condition, some of the sturgeon meat was either pickled in brine or dry salted. Some of these fish were sent east where the flesh was smoked, and occasional shipments were also made to San Francisco. In 1888, 94 tons of sturgeon were salted and pickled. That same year saw the beginning of the sturgeon fishery as an important industry on the Columbia, when S. Schmidt & Co. shipped the first car of frozen sturgeon east from the Columbia.

Also, in the fall of 1888, a sturgeon-fishing camp was established by a New York firm at Oneonta, Oreg., 12 miles below the Cascades and 33 miles, by rail, from Portland, Oreg. The first shipment of frozen sturgeon from this camp was reported to have been made January 16, 1889, and by May of that year 85 tons of fish had been sent east. The venture was a profitable one during the winter months, when the sturgeon were scarce in eastern waters, but in the summer only the roe, which was prepared as caviar, was sent east. This expansion of the sturgeon fishery, which was induced by the advent of freezing methods, gave the sturgeon new value to the fishermen. At first the fish brought only 40 cents each, regardless of size, at the newly established fishery at Oneonta, but the price soon increased to 1½ cents per pound for dressed fish. In fact the sturgeon fishery soon became of substantial importance, being second in value to only the salmon. Since this early sturgeon fishery did not begin until about the middle of August or the first of September, and ended in April, it did not interfere with the salmon fishery and so gave the fishermen an opportunity to earn extra money. In 1892 the sturgeon fishery added $41,743 to the salmon fishermen's income and in 1895, $65,992.

The following description of the freezing method used at the first sturgeon-fishing camp at Oneonta is taken from Wilcox, 1895.

> As soon as the fish are landed at the packing house a gang of employees dress them for market. In some cases the skin is removed, in others it is left intact. After dressing, the fish are cut into sizes to fit the freezing-pans, which are then placed in bins, covered with ice and salt, and frozen into solid cakes. After freezing, the blocks of sturgeon are removed from the pans and placed in boxes, holding from 200 to 250 pounds, which are loaded into refrigerator cars and shipped to market. Most of the catch has been sent to Sandusky, Ohio, Chicago, Ill., and New York City, where it is smoked and finds a ready sale at good prices.

As it became evident that this venture was successful and profitable other firms engaged in the business, so that by 1890 three companies, and in 1892 four companies were freezing sturgeon.

The sturgeon fishery held its place as a major part of the commercial fisheries of the Columbia for only a brief time. Its peak of production was reached in 1892, when about 6,000,000 pounds of fish were landed by the fishermen. Immediately thereafter acute depletion of the stock became evident and the high production level could not be maintained even by the addition of more gear. Therefore, the catches declined so that in 1899, only 10 years after the intensive fishery started, the total catch was less than 100,000 pounds for the river. From that time on the sturgeon fishery has been merely incidental to the important salmon fisheries of the region.

In the early days of the fishery there were four products taken from the sturgeon; the flesh, roe, spinal marrow, and sounds, or swim bladders. Some of the flesh was sold fresh in the local markets, and after 1889 it was also frozen and shipped by rail. Along the lines of the transcontinental railroads the frozen meat was thawed out and sold fresh, while much of that which reached Eastern cities was smoked before being marketed. When the fishermen were receiving from 1 to 2 cents per pound for the dressed fish it sold for about 10 cents per pound in the Eastern markets. The fishermen received 5 cents per pound for the roe. The sounds were used in manufacturing isinglass, and the fishermen were paid 5 cents each for them. The spinal marrow or "bone" was removed by the Chinese and prepared and dried for use in the making of soups. Some of this product was sold to Chinese in this country and the remainder was exported to China. At the present time neither the sounds nor spinal marrow are saved. Caviar is still made from the roe and most of the flesh is disposed of locally or shipped frozen. During the last few years there has been some smoked sturgeon canned in oil. This appears to be a satisfactory product, but the small supply of fish available has limited the business to a small output.

## FISHING METHODS AND GEAR

Until 1880 sturgeon were caught incidentally to the salmon fishery. Seines, wheels, gill nets, and traps all captured these fish. As sturgeon fishing became a definite and specialized occupation two types of gear were developed for the taking of those fish. These were set, or trawl lines, and large-mesh gill nets. The gill nets were made of cotton webbing with meshes from 12 to 19 inches, stretched measure, and were from 600 to 900 feet long. These nets were quite generally used in the upper

Columbia and lower Snake Rivers during the winter of 1895 and 1896. Their use in these locations evidently came about after 1893 since Wilcox, in describing the set-line fishery of that time, states:

> With the exception of a few gill nets employed in the lower river the fishing is carried on exclusively with set lines. Each line is provided with 200 to 400 hooks, the hooks being one foot apart, and 5 to 8 lines constituting the complement of each fishing boat. When the fishing was first inaugurated lampreys were used for bait, but in the following year the Chinese method of using baitless hooks was found successful and has since been universally practiced. The hooks differ from those used by the Chinese, however, in being barbed, but resemble them in being ground to a needle-like point. The lines, as a rule, are anchored across the bed of the river, in some cases diagonally, and also in the bays formed by the expansion of the river. At intervals of 7 feet a junk bottle or block of wood is fastened to the line to buoy it up and maintain it in position about 4 inches from the bottom. The fishermen closely study the movements and habits of the sturgeon and set their lines on the grounds most frequented by them. The fish swimming along the bottom of the stream in search of food, as is their habit, must necessarily cross the set lines, and are almost certain to be snagged by one or more of the sharp-pointed hooks. In attempting to free themselves more hooks are apt to be caught in their body and they are held fast. Occasionally fish are taken showing healed-up scars, evidence of previous capture and escape. The lines are tended on the slack tide and are usually visited only once in twenty-four hours.

In 1899 it became unlawful to use the Chinese sturgeon lines and, as the sturgeon became less abundant, it was not profitable to own the sturgeon nets. Therefore, at the present time most of the sturgeon are taken in salmon gear incidental to that fishing; the remainder being taken by set lines.

## ABUNDANCE OF STURGEON

All available evidence points to the fact that sturgeon were extremely abundant in the first years of the Columbia River fisheries. The various types of gear which were used in the capture of salmon—gill nets, seines, wheels, and traps—all caught sturgeon, and from the comments of early writers it appears that large quantities of these fish were caught before 1880, at which time a market began to develop for the sturgeon. During the time when the fishermen were unable to dispose of the sturgeon they were considered a nuisance and a detriment to the fishery. The fishermen were of this opinion because the sturgeon often became gilled or entangled in gill nets, or the webbing of traps, where their large size and arrangement of bony plates on their sides caused them to tear and damage the gear. They were also often caught in seines and wheels and were a source of annoyance to the operators of those varieties of gear. The result was that the fishermen, regarding the sturgeon as useless and a hindrance to their operations, destroyed as many as possible. Consequently the sturgeon population was subjected to a considerable fishing strain starting with the development of the salmon fisheries in about 1870, even though they were not exploited until after 1880.

Some idea of the original abundance of the sturgeon, and their destruction during the first years of the salmon fishery, may be gained from the following quotation from Mr. M. J. Kinney, one of the early cannery operators (Smith, 1895):

> In 1879 the sturgeon were so thick in Baker Bay that we did not consider it safe, early in the season, to put our gill nets out. The fish were so numerous and large that they were able to destroy a great amount of netting. For years every sturgeon taken was mutilated or killed with an ax and thrown back into the water. The shores of the river would be lined with dead sturgeon, and numbers could always be seen floating down the river. It is quite different now.

When the sturgeon fishery began, only fish of 50 pounds or more in weight were purchased and little or no effort was made to return the smaller, unmarketable fish to the river uninjured.

In 1892, which was only the fourth year of intensive fishing and exploitation, the sturgeon fishery reached its peak of production on the Columbia. This was achieved by the addition of more gear and a shifting of fishing grounds, and even at that early date the fishermen were complaining because of the scarcity of the fish. The abundance of sturgeon dropped markedly during 1893, and still further in 1894, and by 1895 the fishery had been extended several hundred miles up the Columbia and into the Snake River. In that year some of the most enterprising fishermen continued on up the Columbia with five boats, prospecting for sturgeon as they went. If fish were found and a catch made they were shipped down river by the railroad. Shipments were made from Arlington, Stokes, Coyote, and Castle Rock, Oreg. Sturgeon were more abundant at the mouth of the Snake River than any place previously prospected, so that fishing was carried on there and also up the Snake as far as Wieser, Idaho. The catch of 35,000 pounds of dressed fish made in the Snake River was not large enough to induce the fishermen to repeat the venture. In the few reaches of deep water occurring on some of these new fishing grounds sturgeon were often found to be very plentiful and of large size. For a short time large catches were made, but soon the sturgeon would be greatly diminished in numbers on that particular ground.

The sturgeon from the Snake were large, ranging from 100 to 500 pounds, with an average of 150 pounds. Formerly the sturgeon of the lower river had been large also but, by 1895, the average weight of the fish taken and saved was from 50 to 60 pounds. Many small sturgeon weighing from 6 to 12 pounds were destroyed by the gill netters on the lower river.

The condition of the sturgeon fishery is outlined in the following quotation taken from a letter written by C. B. Trescott to the United States Fish Commissioner on February 15, 1894 (Smith, 1895):

> Sturgeon fishing has completely failed on the Columbia. There has been no fish caught since last November to amount to anything. At present the entire catch on the river does not amount to over 1 ton of dressed fish a day, and is growing less. We do not expect to be able to fish longer than the 15th of March, and what few we get now do not pay for handling. At present we do not have much faith in the sturgeon business on the Columbia. Usually we have a good run of fish in January or February, but there are no fish this year and there is every indication of the fish being caught out. We have thought that we would have our usual run of sturgeon on the Columbia in January and February. The sturgeon season will begin again on the 15th of August, and if we do not have our usual run of fish then it will prove that the sturgeon fishing is done for here. There is every indication of the sturgeon business having seen its best days on this coast. The total catch for this season has not been 25 per cent of the catch of last season, and what fish were caught were caught in August, September, and October.

TABLE 26.—*Sturgeon production of the Columbia River* [1]

| Year | Washington | Oregon | Total | Year | Washington | Oregon | Total |
|---|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | | *Pounds* | *Pounds* | *Pounds* |
| 1889 [2] | | | 1,746,736 | 1926 | 76,880 | 132,262 | 209,142 |
| 1890 | | | 3,084,925 | 1927 | 80,676 | 130,835 | 211,511 |
| 1891 | | | 3,561,998 | 1928 | 61,266 | 86,256 | 147,522 |
| 1892 | | | 5,466,831 | 1929 | 66,463 | 93,184 | 159,647 |
| 1895 | | | 4,704,469 | 1930 | 54,660 | 74,581 | 129,241 |
| 1899 | | | 73,295 | 1931 | 43,990 | 68,866 | 112,856 |
| 1904 | 128,809 | 8,854 | 137,663 | 1932 | 30,966 | 40,466 | 71,432 |
| 1915 [3] | 37,088 | 97,785 | 134,873 | 1933 | 38,915 | 45,553 | 84,468 |
| 1923 | 68,945 | 113,911 | 182,856 | 1934 | 31,000 | 48,100 | 79,100 |
| 1925 | 93,053 | 138,309 | 231,362 | | | | |

[1] Data from Report of Fishery Industries.
[2] Data appearing from 1889 through 1899 converted to round fish on the basis of a 45-percent dressing loss.
[3] Green sturgeon entered catch in 1913.

The decline of the sturgeon fishery of the Columbia from that time to the present is shown by the total catch figures presented in table 26. Two factors which have influenced the trend of these figures were the prohibition of the use of Chinese type of trawl lines in 1899, and the use of green sturgeon for food which began in about 1913. The legislation against the Chinese lines, which went into effect in 1899, no doubt lowered the total catch at that time, and the addition of green sturgeon to the catch in about 1913 raised it to some extent. However, the rapid diminution of the total catch and the past history of the fishery is convincing evidence of the fact that the sturgeon population of the Columbia has been depleted to a point where it is almost commercially extinct.

It was not until 1897 that the sturgeon received any protection. In that year Washington passed a law which made possession of sturgeon between March 1 and November 1 illegal, and also made it unlawful to take, kill, or fish for any young sturgeon under 3½ feet in length. Also sturgeon under 4 feet were to be released uninjured when caught. In 1899 Oregon passed the same season regulation, made 4 feet the minimum length of sturgeon to be taken and killed, and prohibited Chinese lines. Washington then changed its regulations to agree with those of Oregon. Since then the regulations governing the sturgeon fishery have been changed slightly from time to time. At present the closed season is the same as for salmon, the minimum length of fish to be taken is 4 feet, and the Chinese sturgeon lines are still prohibited.

## SMELT FISHERY OF COLUMBIA RIVER BASIN

The Columbia River smelt, *Thaleichthys pacificus*, is found from Oregon northward, being particularly abundant in the Columbia and Fraser Rivers. These small fish, from 5 to 8 inches in length at maturity, are of a delicious flavor and exceedingly rich in fat. They are sometimes called candle fish because they have at times been made to serve as candles by the simple expedient of placing a wick in them after they have been dried. Another common name applied to the species is eulachon.

They are anadromous, entering the Columbia during December, January, and February in dense schools, after which the majority of them ascend the Cowlitz, Lewis, and Sandy Rivers, where they spawn. A few use other lower tributaries, but these three streams are the main spawning grounds of the smelt in the Columbia River system. They are apparently like the Pacific salmon in not surviving after spawning. Unfortunately but little accurate information is available concerning the details of their life history.

These fish were sought after and used for food by the Indians, who caught them in dip nets. George Rogers Clark mentions purchasing them from Indians in 1805 and presented a description and drawing of a specimen in his account of the Lewis and Clark expedition.

During the time when the smelt are in the main river they are taken commercially by fishermen using drift gill nets. These nets are the ordinary "floater" type and about 1,500 feet long. The mesh is from 1¼ to 1½ inches, stretched measure, and is woven of linen twine. This type of fishing is carried on in the main Columbia from Cathlamet to Oak Point, Wash., a distance of about 12 miles. As soon as the smelt enter the smaller tributaries, great numbers of them are caught with dip nets. Many people participate in this fishing for sport and to obtain the fish for their own use. The smelt are sometimes present in such dense schools in the tributaries that many individuals can be taken with one scoop of a dip net.

There is no definite information available as to the exact time when smelt became commercially important, but that this occurred at an early date is indicated by the fact that good-sized catches were being made as early as 1895. An attempt was made to dispose of smelt in a distant market when a firm of fish dealers in Kalama, Wash., shipped a carload of 20,000 pounds to New York City in 1892. They were reported to have disposed of these fish without difficulty, but there is no record of any further shipments. It was soon discovered that these fish, although extremly fine and palatable when consumed fresh immediately after capture, would not stand freezing and so their use has been confined to markets in the vicinity of the Columbia River.

TABLE 27.—*Smelt production of the Columbia River* [1]

| Year | Washington | Oregon | Total | Year | Washington | Oregon | Total |
|---|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | | *Pounds* | *Pounds* | *Pounds* |
| 1894 | 300,000 | | | 1912 | 200,000 | 320,336 | 520,336 |
| 1895 | 251,125 | [2] 31,125 | 282,250 | 1915 | [2] 1,625,605 | | |
| 1896 | 677,350 | 677,350 | 1,354,700 | 1916 | 835,183 | | |
| 1897 | 344,000 | 677,480 | 1,021,480 | 1917 | 1,633,700 | | |
| 1898 | 287,000 | 450,000 | 737,000 | 1918 | 2,405,300 | | |
| 1899 | [3] 280,420 | [3] 280,500 | [3] 560,920 | 1919 | 977,084 | | |
| 1900 | 227,400 | 260,200 | 487,600 | 1923 | 911,195 | 277,195 | 1,188,390 |
| 1901 | | 255,380 | | 1925 | 1,249,264 | 308,676 | 1,557,940 |
| 1902 | 450,000 | 122,454 | 572,454 | 1926 | 466,109 | 72,900 | 539,009 |
| 1903 | 300,000 | 102,000 | 402,000 | 1927 | 1,149,670 | 411,732 | 1,561,402 |
| 1904 | [2] 425,322 | 15,138 | 440,460 | 1928 | 1,158,419 | 10,000 | 1,168,419 |
| 1905 | 340,000 | 143,015 | 483,015 | 1929 | 1,281,994 | 37,500 | 1,319,494 |
| 1906 | 340,000 | 163,000 | 503,000 | 1930 | 1,607,416 | 188,229 | 1,795,645 |
| 1907 | 340,000 | 169,804 | 509,804 | 1931 | 1,535,140 | 472,458 | 2,007,598 |
| 1908 | 340,000 | 262,022 | 602,022 | 1932 | 1,461,778 | 233,143 | 1,694,921 |
| 1909 | 350,000 | 209,608 | 559,608 | 1933 | 1,054,235 | 540,968 | 1,595,203 |
| 1910 | 175,000 | 272,478 | 447,478 | 1934 | 2,199,100 | 564,000 | 2,763,100 |
| 1911 | 175,000 | 174,639 | 349,639 | | | | |

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[1] Data for the following years from the State Reports: 1894, 1896–1903, 1905–12, 1916–19. Data for the following years from the Report of Fishery Industries: 1895, 1904, 1915, 1923, 1925–34.

[2] State Report for Oregon for 1895 gives 545,800 pounds. The State Report for Washington for 1904 gives 300,000 pounds; for 1915, 2,321 pounds.

[3] The Report of Fishery Industries for 1899 gives, for Washington, 502,000 pounds, and Oregon, 28,000 pounds; totaling 530,000 pounds.

Plans were made for an experimental cannery and packing plant for the handling of smelt to be installed in an old salmon cannery at Kelso, Wash., during the winter of 1916–17, but apparently no satisfactory pack was put up. There is no record of any other attempt having been made to can these fish.

The total yearly catch figures shown in table 27 are not an index of the abundance or availability of the smelt. Because of the difficulties in preserving and shipping smelt for long distances, which have been mentioned, the amount of these fish handled commercially depends on the local demand, and so far the supply has been adequate for this purpose. Therefore, the commercial catch is more of an index of the demand for smelt than of abundance. Also, the sport or noncommercial fishermen take a very significant catch, of which there is no record. In recent years there has been some concern because of an apparent falling off of the size of the smelt runs into the Lewis and Sandy Rivers.

# SUMMARY

1. The Columbia River, approximately 1,210 miles long and rising in Columbia Lake, B. C., has a basin area of about 259,000 square miles; 39,000 of which are in Canada. It has two principal tributaries, Clarks Fork and the Snake River, and drains parts of Oregon, Washington, Idaho, Montana, Wyoming, Utah, and Nevada. It was discovered by an American, Robert Gray, in 1792. Spain, Russia, Great Britain, and the United States all had claims to this territory. Spain and Russia gave up their claims at an early date and the present boundary between the United States and Canada was fixed by treaty in 1846.

2. The Indians of the Columbia Basin depended upon the runs of salmon for one of their chief sources of food before white men arrived in the region. While an accurate estimate of the amount of salmon which they consumed cannot be made, it is possible that they may have taken as much as 18,000,000 pounds of these fish annually. These natives had remarkably efficient fishing gear which consisted of haul seines, dip nets, spears, bone hooks, jump baskets, and weirs. They also had canoes, hollowed out of logs, some of which were large enough to carry 50 people.

3. Soon after the first white inhabitants became established in the Columbia Basin they began to use fresh salmon and to preserve them with salt. From 1830 to 1865 salt salmon was exported to the Hawaiian Islands, South America, China, California, and the East coast of the United States.

4. The extensive salmon fisheries of the present time had their beginning when Hapgood, Hume & Co. established the first salmon cannery at Washington, Calif. They later operated the first cannery on the Columbia at Eagle Cliff, Wash., in 1866. This industry increased with amazing rapidity. By 1883 there were 39 canneries on the Columbia and in recent years their number has fluctuated between 10 and 24.

5. Improvements in canning methods and machinery have increased the capacities of the canneries enormously since the inception of the industry. These advancements have taken place in practically all of the processes involved in fish canning, can making, evacuating, can protection, labeling, and butchering.

6. Foreign countries were the principal markets for canned salmon until the late eighties, when the domestic trade increased to a point where it surpassed that carried on with England.

7. Early settlers and traders salted salmon, the business becoming relatively large in the early sixties. Mild-curing became important between 1895 and 1900. The mild-cured pack has been between 1,000 and 3,000 tierces yearly since the World War.

8. In 1888 a fish-freezing plant was erected in Portland, Oreg. At first all species of salmon were frozen but now only chinook and silver salmon and steelhead trout are used.

9. Salmon oil was extracted as early as 1871. At present high-grade oils and meals are made by modern machinery, but this part of the industry has never attained large proportions.

10. The first type of gill net used was the floater. Diver nets appeared in about 1900, and since that time trammelled, combination, and apron nets have come into use.

11. The modern pile-and-webbing traps supplanted the old wooden slat traps in about 1894 and were an important type of gear prior to 1935, when their use was prohibited on the Washington side of the river.

12. Indians first used haul seines on the Columbia and their use has been continued by the white men, with several improvements in materials and design.

13. Fish wheels were used in the section of the river lying between a point about 30 miles above Portland, Oreg., and Celilo Falls. They were an important variety of gear at one time, but their use has been prohibited in Oregon since 1927 and in Washington since 1935.

14. Set nets are fixed in suitable locations where they gill the fish which swim into them. They have always been relatively unimportant.

15. The dip-net fishery has remained almost entirely an Indian fishery and is carried on now principally in the vicinity of Celilo Falls.

16. In about 1912 it was discovered that chinook and silver salmon could be taken by trolling off the mouth of the Columbia. The fishery reached its peak in about 1919. Chinook salmon hatched in the Columbia are caught by trollers as far distant as the coast of British Columbia.

17. Purse seines were used in the Columbia from 1905 to 1911 and again in 1917. However, their use was restricted and prohibited by legislation passed in 1917 and 1922.

18. The Columbia River gill-net boat, a distinct style developed soon after the inception of the salmon-canning industry, came into general use from southern California to Alaska. Motorization of the fleet was begun about 1900 and completed by 1915. The first departure from this type boat, the one-man boat, appeared shortly after 1920. Diesel or gas-powered launches, averaging about 11 tons net capacity, are used for picking up the fish on the fishing grounds. Work launches and large skiffs are used in manipulating seines.

19. Adequate spawning escapements and favorable conditions on the spawning grounds are necessary for the continued productiveness of the salmon fisheries. Originally the Columbia Basin provided a highly suitable habitat, but settlement and development of the area have greatly modified this condition.

20. Settlement of the Columbia Basin began early in the nineteenth century. The arrival of missionaries, fur traders, farmers, and miners, taking place in the early part of that century, was the beginning of the movement. Later, construction of the transcontinental railroads and the development of the lumber industry caused large additions. Lumbering, mining, hydroelectric power developments, irrigation, and flood-control projects have all been undertaken in the Columbia Basin and have all adversely affected the spawning and rearing habitats of the salmon to some extent.

21. The fish populations of the Columbia River have been decimated by the development of the commercial fisheries, the deleterious effects of the various industries which have developed in the basin, and by the direct loss of spawning areas.

An adequate number of spawners can be provided by regulating the fishery. The problem of providing a suitable habitat for the adult spawners, the eggs, and the young is more complex and can be solved only by coordinated planning and adequate fish protection at projects which interfere with proper conditions in regard to fish life.

22. Chinook salmon are the most important species on the Columbia, both in point of total poundage and value. In the beginning of the industry they were the only species utilized. The production of this species reached an all-time production

peak of over 42,000,000 pounds in 1883. A sharp drop then occurred, followed by a period of stability, and then a gradual decline from 1911 to 1935. A growing utilization of the less-desirable fall runs of Chinooks has been a feature of this fishery.

The blueback catch shows wide variations. Its largest value was attained from 1889 to 1900. Since 1923 there has been a pronounced fall in catch due to a scarcity of fish.

The chum-salmon catch shows wide fluctuations, due both to natural changes in abundance and economic influences.

The steelhead-trout catch does not show any significant trend until the last few years, from 1926 to 1936, when it dropped from a level of about 4,000,000 pounds annually to about 2,000,000 pounds. Regulation of the fishery and loss of market, as well as curtailment of the spawning grounds, have probably helped to produce this condition.

The annual catches of the silver salmon show a rising trend until 1924 after which the general direction is downward, with several large fluctuations. Troll fishing has been an increasingly important factor in the catch of this species.

23. The shad is an Atlantic coast species, planted first on the West coast in California in 1871, and then in the Columbia River in 1885 and 1886. The success of these two plantings in the Columbia is remarkable because the shad's abundance had depressed its market value as early as 1893. The lack of demand and low value result in the catch being largely incidental to the salmon fisheries, the resulting catch data showing demand only and not abundance of the species.

24. Two species of sturgeon inhabit the Columbia; the white and the green. The former species is the larger and more desirable commercially.

The sturgeon fishery began in 1880. Sturgeon were marketed fresh, pickled, dry-salted, and smoked. The peak of production of the fishery was reached in 1892, when about 6,000,000 pounds of fish were taken. Most of the sturgeon are now sold fresh or frozen.

These fish were originally very abundant on the Columbia. This abundance began to decline sharply in 1893 and has now reached a very low point.

25. Columbia River smelt are anadromous. They are caught with drift gill nets and with dip nets. Poor shipping qualities have limited their use to the local markets.

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